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U. S. DEPARTMENT OF AGRICULTURE.

Report No. 76.

REPORT

OF THE

SECRETARY OF AGRICULTURE.

1903.

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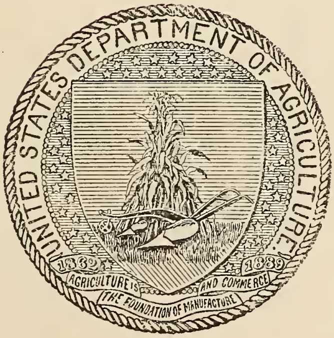

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REPORT

OF THE

SECRETARY OF AGRICULTURE.

To the President:

I have the honor to submit herewith my Seventh Annual Report as Secretary of Agriculture.

EDUCATIONAL REQUIREMENTS OF AGRICULTURAL RESEARCH.

The research work of the Department of Agriculture covering the sciences of production in the fields and other laboratories where the crops of the country are grown and where they are made more valuable by skill, has required a class of experts not educated by the institutions of learning where our people have heretofore been prepared for their life work. The development of the Department toward doing all that should be done to help our people secure a greater yield from the soil and enhance the value of its products, made the training of experts in the Department a necessity.

The country needed scholars along all the lines of work considered in this report. The agricultural colleges of the States are the natural sources from which students for this work should be expected to come, and we have availed ourselves of all the competent graduates of these institutions that could be induced to take up advanced work with us; but the demand has been so great, and the growth of the Department so rapid, that we have been compelled to seek the most competent men wherever we could find them.

The theory of our duty is to help any locality that is struggling with a problem to an early solution of which the experience of our scientists may contribute or where the undertaking is beyond the means at the disposal of the people interested.

To these ends many specialists must be trained, and for these purposes the Department has become a post-graduate institution where groups of sciences are taught and applied. Comparatively little time is devoted to the ascertainment of abstract scientific facts. Every worker is helping somebody, and while doing this he is contributing to what is known relating to the farm, and to the education of his associates.

Four hundred and ninety-six students have been admitted to the Department for instruction since 1897 as experts in our several lines of work. Two hundred and forty-nine of these still remain with us, not less than 132 having passed into the classified service; 185 have gone elsewhere to teach, experiment, or demonstrate in private enterprise what they have learned from their teachers, who are our best-equipped scientists in their several specialties.

The Department has been extending its work in all parts of the country during the past year wherever the producers from the soil most need help. Our most active efforts have been directed to the stamping out of foot-and-mouth disease in four of the New England States, and in studying the cotton boll-weevil in Texas and demonstrating the growing of cotton successfully in spite of the presence of the pest. Encouraging progress has been made in all the lines of research with which the Department is charged.

OUR SURPLUS PRODUCTION.

Out of their continued abundance, during the past year, the farmers of the nation have contributed food and raw materials for manufactures to hundreds of millions of people in foreign countries, besides sustaining 80,000,000 at home.

A survey of half a century discovers the remarkable character of the movement in which the farmers of this country have become the chief purveyors of the world.

In 1851 our shipments of farm products were valued at $147,000,000, while half a century later, in 1901, they amounted to $952,000,000, an increase of $805,000,000, or about 550 per cent. The farmers' export trade for the decade 1851–1860 amounted to $1,896,000,000, and in the following decade, in spite of the transfer of multitudes of men from productive to destructive life, the total was $2,431,000,000. In the decade after that, the export trade doubled and amounted to $4,864,000,000. In the next decade, the amount grew to $5,740,000,000, and the total for the decade of 1891–1900 was $7,032,000,000, or an average of over $703,000,000 a year. Subsequent to the last-named period this trade has gone on increasing and reached its highest amount in 1901 with exports valued at $952,000,000. The export trade in farm products for 1903 was valued at over $878,000,000, an amount second only to that of 1901.

The consumption of cotton in this country is now greater than that of any other country, and yet the cotton planters of the South not only supplied this market last year, but exported a surplus of 3,569,000,000 pounds, valued at $317,000,000, or for every working day in the year about 12,000,000 pounds, worth more than $1,000,000.

Represented in value, the exports of grain and grain products had about two-thirds of the importance of cotton in the last fiscal year, the value of the export being more than $221,000,000. From 46,000,000 acres of wheat there was a surplus for foreign mouths amounting to 114,000,000 bushels and 20,000,000 barrels of flour, amounts that together represent 204,000,000 bushels of wheat.

Third in importance are the exports of meats and meat products, with a grand total of $178,000,000, to which may be added $35,000,000 for live animals. Quantities that are beyond the grasp of the mind represent the exports of meats and their products. The pounds of beef were 385,000,000; of pork, 551,000,000; of lard, 491,000,000; and of oleo oil, 126,000,000.

The foregoing figures, it should be borne in mind, do not stand for the total production of the farms, but for the surplus production after the wants of the people at home have been satisfied.

THE FARMER'S BALANCE OF TRADE.

The immense exports from the farms of the country lead to an examination of the so-called balance of trade. This examination reveals what seems to have escaped the attention of the public, and that is, that the favorable balance of trade, everything included, is due to the still more favorable balance of trade in the products of the farm.

During the thirteen years 1890–1902 the average annual excess of domestic exports over imports amounted to $275,000,000, and during the same time the annual average in favor of farm products was $337,000,000, from which it is apparent that there was an average annual adverse balance of trade in products other than those of the farm amounting to $62,000,000, which the farmers offset and had left $275,000,000 to the credit of themselves and the country.

Taking the business of 1903, the comparison is much more favorable to the farmers than during the preceding thirteen-year period, since the value of domestic exports over imports was $367,000,000, the entire trade being included, while the excess for farm products was $422,000,000, which was sufficient not only to offset the unfavorable balance of trade of $56,000,000 in products other than those of the farm, but to leave, as above stated, the enormous favorable balance of $367,000,000.

During the last fourteen years there was a balance of trade in favor of farm products, without excepting any year, that amounted to $4,806,000,000. Against this was an adverse balance of trade in products other than those of the farm of $865,000,000, and the farmers not only canceled this immense obligation, but had enough left to place $3,940,000,000 to the credit of the nation when the books of international exchange were balanced.

These figures tersely express the immense national reserve-sustaining power of the farmers of the country under present quantities of production. It is the farmers who have paid the foreign bondholders.

MAGNITUDE OF PRODUCTION.

The height to which farm production has risen to supply the demands of domestic and foreign consumption should not be overlooked. Taking the range of recent years, there is the product of wheat, 600,000,000 to 750,000,000 bushels, worth to the farmer from $350,000,000 to $450,000,000. On more than 90,000,000 acres grow 2,000,000,000 to 2,500,000,000 bushels of corn, with a value which ran up to more than $1,000,000,000 on the farm in 1902.

The oat crop now reaches close to 1,000,000,000 bushels, with a value of $300,000,000; the barley crop overruns 100,000,000 bushels, worth $50,000,000, and the rice crop in 1902 amounted to 390,000,000 pounds.

One of the most valuable three of all farm crops is that of hay, aggregating about 50,000,000 to 60,000,000 tons, worth $450,000,000 to $550,000,000; ranging between 200,000,000 and 300,000,000 bushels is the potato crop.

The acreage of the cotton crop has displayed a tendency to increase considerably during the last few years, and in 1903 was about 29,000,000 acres; the number of bales produced in recent years ranges from 10,000,000 to 11,000,000, while the value of the entire crop on the plantations has gone as high as $511,000,000 for the crop of 1900, or, if the seed is included, $530,000,000.

Tobacco is another crop of expanding proportions, and the prospect now is that within a few years ten figures will be required to represent the annual production. This crop has now climbed close to 900,000,000 pounds, valued at $60,000,000.

Only some of the principal farm products have been mentioned, bu- these are sufficient to indicate, in conjunction with information cont cerning the less important products, that the value of all farm products not fed to live stock for 1903 considerably exceeded their value in the census crop year 1899, when it was $3,742,000,000.

NATIONAL STOCK OF FARM ANIMALS.

The Department's inventory of farm animals January 1, 1903, discovers that while some classes of animals are only holding their large proportions, others are increasing. The horses number 16,557,000, with a value of $1,031,000,000. The mules have increased to 2,728,000, with a value of nearly $200,000,000.

Dairying shows marked expansion, and now depends upon 17,105,000 milch cows, with a value of $517,000,000. Other cattle of all sorts number 45,000,000, with a value of $824,000,000.

The number of sheep has had a tendency to decline at times during the last score of years, but within the last four years has increased decisively, so that now the sheep number 64,000,000, with a value of $168,000,000.

Hogs have remained about stationary in number for many years, and in 1903 were found to be 47,000,000, with a value of $365,000,000.

BETTER DISTRIBUTION OF PROGRESS.

There is one other particular feature of the farmers' improved and gratifying condition that should be noticed, and this seems to have escaped attention. During the long period of time when the new and productive land of the West was easily obtained, and when the number of farms and the amount of production there multiplied at an amazing rate, the farmers of the East and the South suffered under a severe competition and an impending overproduction, and agriculture in these sections, apart from cotton production, was outstripped in the agricultural expansion of the West. Since 1890, however, there has been a turn in the trend of this expansion; the northern half of the Mississippi Valley is not overshadowing the other sections of the country in its rate of expansion as formerly; an improvement in the welfare of farmers in other sections of the country, as well as in the North Central States, is in evidence. In other words, there is a more even distribution of expansion, progress, and welfare than before.

The South, which had been backward in its corn production for many years preceding 1890, finds itself since that time with its fraction of the national production of corn increasing faster than that of any other section; the same is true with regard to wheat, sweet potatoes, and cane and sorghum sirup; and to these may be added tobacco and farm-made butter, and horses, mules, and swine. The South occupies a second place in the rate of increase of production, in comparison with other sections, in buckwheat, hay, apple and peach trees, cattle other than milch cows, and farm-made cheese.

In a similar way, agriculture in the East is rehabilitating itself by gaining faster than in other sections of the country in the production of buckwheat and potatoes, while it stands second in order among the different sections in its increasing production of rye and of sweet potatoes, and in the number of milch cows.

The group of States embracing the Rocky Mountain and Pacific Coast region is showing a larger gain relatively than other sections in the production of rye, hay, apple trees, and farm cheese, and in the possession of sheep and milch cows; while it holds a secondary place in relative advancement in the production of wheat, oats, barley, potatoes, and farm butter, and in the possession of horses, mules and swine.

The North Central States have by no means lost for all products the foremost place in rapid rate of advancement that they have enjoyed for many years. Since 1890 this section has increased its production faster than other sections for oats, barley, flax, peach trees, and cattle other than milch cows; and this section does not stand second in rate of advancement in any of the products under consideration.

Thus, it appears that a new life has come to agriculture in all parts of the country, and that there are achievement, hope, and promise for the farmer everywhere.

The above review of our agricultural products and exports is presented not only in grateful acknowledgment of the bountiful Providence which has so generously filled our cup of prosperity, but also from a desire to present thus succinctly to the statesmen and to the men of affairs of this country the value and importance of this vast agricultural industry, supported by three-eighths of our working population, and contributing so greatly to the prosperity of the whole country. It is this vast constituency and still vaster industry that the Department of Agriculture is charged to protect, cherish, and encourage, and its extent can only be appreciated by those who are not brought continuously in direct contact with it, by the perusal and study of the foregoing figures and consideration of the important facts they present.

WEATHER BUREAU.

The Weather Bureau has, through its officials at the various stations throughout the country, taken an active part in public education along meteorological lines. In 12 colleges or universities during the past year Weather Bureau officials have conducted regular courses of lectures or classes of instruction in meteorology and climatology, and at 5 of these institutions the official is a member of the faculty. At 16 stations the officials have delivered occasional addresses outside of their offices to schools or colleges, and at 28 stations they have given frequent talks in their offices to pupils and teachers of schools. In 14 instances they have delivered occasional addresses outside of their offices to farmers' institutes and similar organizations. Only a few years ago there was very little instruction of this nature given in our colleges, universities, or public schools, but the demand for it has rapidly increased. The action of the Bureau in this direction will undoubtedly result in a wider knowledge and a more intelligent understanding of its work, and a consequent increase in its usefulness and value. Many of the young men who receive instruction in these classes are attracted to the service of the Bureau as an occupation, and the Bureau profits by securing a class of employees with special training and equipment.

The year 1902–3 marks a distinct advance by the Weather Bureau in the science of meteorology, especially in two directions. From the beginning of the weather forecasts by the Government, in 1871, the necessary observations at the several stations have always been reduced to the sea-level plane. It was conceived some years ago that the numerous defects in forecasting might be diminished, and the uncertainty as to the true cause of storms removed, if similar daily charts were also constructed at higher levels, for which purpose the 3,500-foot and the 10,000-foot planes were selected. After much laborious computation, as shown in the barometry report of 1900–1901, the necessary reductions were made, and we now possess daily weather charts on the three planes mentioned. The study of these supplementary maps is going on, with encouraging prospects of more reliable forecasts of the weather conditions, and it is hoped by January 1, 1904, to make them a part of the regular daily work of the forecasting service. At present the improved data are confined to the barometric pressures, but it is most important to secure charts of the temperature on the two upper planes as well. Unfortunately, we have no observations of temperature in the higher atmosphere suitable for this purpose, and they can be secured only by means of numerous balloon and kite ascensions carrying the necessary self-registering instruments.

It has been thought proper for many reasons to establish on the Blue Ridge Mountains, at Mount Weather, Bluemont, Va., a modern meteorological observatory of the best class for scientific research pertaining to problems of weather phenomena. A building for administration and for a school of instruction is being erected, and the plans are well advanced for a suitable power house and shop for balloon and kite ascensions, which will be built during the coming year. The recent advances in solar and terrestrial meteorology justify us in preparing to study at first hand the variations in the solar activity, and the corresponding changes in the weather conditions, especially from season to season. It is a complex problem and will require the best instrumental equipment, the ablest students, and a long series of observations before it can be finally solved. The desirability of being able to foresee a year in advance the type of season probable during a given period is so great as to make it imperative to lay broad scientific foundations at the beginning of the twentieth century, which will be of utility for future generations, who will surely build a great science of cosmical meteorology upon such data as can be supplied by the Mount Weather Observatory.

SUBMARINE CABLES.

New submarine cables in connection with the vessel-reporting and storm-warning services have been laid from Sand Key to Key West, Fla.; from Southeast Farallone to Point Reyes, Cal.; from Block Island to Narragansett Pier, R. I.; and from Glen Haven to South Manitou Island, Mich., a total of about 50 miles. Additional vessel-reporting stations have been established at Sand Key, Fla., and Southeast Farallone, Cal.

To meet the demands of the maritime and commercial interests of the Pacific coast a cable has been laid to connect San Francisco and the Farallone Islands, with a weather observatory and vessel-reporting station on the South Farallone Island. A wireless station has also been installed there to insure communication in future should the cable be out of order.

RIVER AND FLOOD SERVICE.

The work of the river and flood service, owing to the numerous and disastrous floods that occurred, has been a prominent feature of the year. Several of the floods were the greatest of which there is authentic record, and were remarkable both for their wide extent and for their destructive character. Our warnings were prompt and timely, and in the main remarkably accurate; and in no instance was the coming of a dangerous flood unheralded. The forecasts of the great floods of March, April, and June, 1903, afford noteworthy examples of the efficiency of this service. This should be extended to the Kansas and other rivers, where no stations have yet been established.

DISTRIBUTION OF FORECASTS AND SPECIAL WARNINGS.

Inadequate appropriations have prevented any extensions in the important work of distributing forecasts and special warnings, and of necessity our efforts have been confined to maintaining the service already in operation, with its various ramifications, and adopting such suggested improvements as might be effected without additional expense.

A marked increase (nearly 20,000) is shown in the number of places receiving forecasts by telephone without expense to the Government of the United States, and with the rapid extension of "farmers' telephone lines" opportunity is afforded for placing weather information directly in the homes of the more progressive agriculturists, as well as in the telephone exchanges of rural centers of population, where it is posted for the general information of the public.

NATIONAL CLIMATE AND CROP BULLETIN.

The National Climate and Crop Bulletin has been issued in the usual form, with charts showing the current temperature and precipitation, extremes of temperatures, and the departures from the normal of both temperature and precipitation. In this bulletin the current meteorological conditions are discussed in their relation to crop growth from the beginning to the end of the crop season.

BUILDINGS ERECTED AND PROPOSED.

During the past fiscal year, through the appropriations by Congress, it has been possible to erect buildings for use as meteorological observatories for the Weather Bureau at the following-named places, and at a total cost of $32,922.97, viz: Amarillo, Tex.; Modena, Utah; Key West, Fla.; Sand Key, Fla.; Southeast Farallone, Cal.; and buildings are now in course of erection at the following places, the total cost of which will be $70,900, viz: Yellowstone Park, Wyo.; Duluth, Minn.;

Devils Lake, N. Dak.; Havre, Mont.; Mount Weather, Va.; Block Island, R. I.; Narragansett Pier, R. I.

The wisdom of erecting buildings for the exclusive use and under the control of the Weather Bureau becomes more apparent every day. It saves to the Government the amount heretofore paid for rent of office quarters, which in many cases are unsuited to our needs, especially as regards the architecture of the roofs for the exposure of meteorological instruments.

BUREAU OF ANIMAL INDUSTRY.

A marked distinction between our country and all others is the more generous nutrition of our people. Our domestic animals contribute to this result, and furnish a large percentage of our exports. This has been brought about by abundance of comparatively cheap grass and grain rather than through superior knowledge of breeding and feeding. We have developed a track horse, a lard hog, and but little else.

The Bureau of Animal Industry has given standing in interstate and foreign commerce to our animals and their products, and is battling successfully with diseases and disabilities originating at home and abroad. It is considering the wisdom of undertaking systematic cooperation with the State experiment stations in the production of types of animals suited to our varying latitudes and conditions, in order that more economy may be observed in production.

CONTAGIOUS DISEASES OF ANIMALS.

The control of the contagious and infectious diseases of animals is one of the most important lines of work in which the Department is engaged, and this work must become more valuable and of greater necessity as the number of animals in the country increases and as traffic with countries in which such diseases exist is further developed.

FOOT-AND-MOUTH DISEASE.

Last year, for the first time in eighteen years, foot-and-mouth disease was discovered in the United States. The manner in which the contagion was brought in is not definitely known, but it evidently came with some articles of merchandise, as it first appeared near the docks of the port of Boston, and spread from there toward the interior. When the existence of this disease was recognized and brought to the attention of the Department the contagion had already spread over the eastern part of the State of Massachusetts and into the States of Rhode Island, New Hampshire, and Vermont. The whole country was menaced with the plague, and it was only by the adoption of radical measures and by the prompt, efficient, and indefatigable work of the inspectors that the contagion was controlled and eradicated.

The plan of work was, briefly, to rigidly quarantine all infected premises and the animals upon them, to slaughter at the earliest practicable moment all susceptible animals on such premises, and to disinfect the stables, pens, and utensils in a thorough manner. Operations were begun December 1, 1902, and the last diseased herd in this outbreak was slaughtered May 9, 1903. The cooperation of the executive departments of the several affected States was prompt and complete, and enabled the Federal authorities to enforce regulations and stamp out the disease wherever it was found. The number of animals slaughtered on account of this disease was 4,461, of which 3,872 were cattle, 360 hogs, and 229 sheep and goats. There was allowed by this Department 70 per cent of the appraised valuation as indemnity. The total amount thus paid was $128,908.57. There were other expenses, such as for salaries, traveling, labor, disinfectants, etc., which were additional to this amount, but the total cost of the eradication of the disease was less than $300,000.

The stock raisers of the country were saved from a great calamity by the successful termination of this work. It is the general history of the disease in other countries that where an outbreak assumes the proportions of the one which existed in New England last winter it spreads over the whole country, affecting sooner or later practically all of the cattle and a large part of the sheep and hogs. As the value of grown cattle shrinks from 20 to 30 per cent in consequence of the disease, as some of these die, together with a considerable proportion of the young animals, and as hogs and sheep are also seriously affected, it is plain that the direct losses from a general extension of the contagion over the country would be some hundreds of millions of dollars, while the indirect losses from domestic quarantines and restrictions on traffic and from embargoes on our export trade would be simply incalculable. These losses were avoided, because the Department had a force of competent and trained veterinarians who were at once taken from their duties in other parts of the country and concentrated in the infected section, and who loyally and cheerfully endured the hardships of a winter campaign in the rural districts, where the cold much of the time was extreme, the roads blocked with snow, and the difficulties connected with the disposal of the carcasses of slaughtered animals and the disinfection of the premises were almost insurmountable.

SHEEP SCAB.

Energetic work has been carried on during the year with the object of controlling as effectually as possible the contagious disease of sheep known as scabies, or scab. Heretofore but little has been done for the repression of this disease except in the channels of interstate commerce, and it was hoped that the prohibition of the shipment of diseased sheep would be sufficient to cause the owners of such animals to treat them on the farms and ranges, and thus eradicate the contagion. While this result followed in some cases, it is unfortunately true that the greater part of the owners of this class of animals have neglected to take proper measures and have apparently relied upon their ability to elude or deceive the inspectors and run their animals through to market without the actual condition being discovered. The attempts to accomplish this have kept the stock cars and stock pens used for animals in interstate commerce so thoroughly infected that satisfactory progress with the disease could not be made. It was therefore determined to cooperate with some of the worst infected States, and attack the contagion at its origin by stamping it out on the premises where it exists and propagates from year to year. This has required somewhat of an increase of the field-inspection force, but it is apparently only in this way that the disease can be controlled.

The inspectors have inspected in this work during the year an aggregate of 16,444,370 head of sheep, and have supervised the dipping of 2,167,002 sheep, of which 394,636 were dipped twice. This enormous amount of work has had great influence for good, and if continued for a few years, will free the sheep industry from this incubus, which has for many years been the source of great discouragement and loss.

TEXAS FEVER.

The inspection and supervision of cattle in transit from the Texas-fever district has also involved a great amount of work. These animals are capable of spreading contagion through the ticks with which they are infested, and must, therefore, be kept in different cars and yards and driven over different roads from those used for other cattle. It is moreover necessary to inspect many cattle from the district adjacent to the infected section in order to determine definitely that they have not been exposed, and that they may safely be allowed to go forward to market through the channels of interstate commerce without danger to the animals of any other section of the country. This service required the inspection of 1,620,403 cattle from the infected district, and of 389,525 cattle from the adjacent district. To guard against the spread of the contagion by infected cars, 66,116 of these were cleaned and disinfected by the direction and under the supervision of the inspectors.

It is well known that if Southern cattle are entirely freed from that species of ticks known as the *Boophilus annulatus* they can be allowed to mingle with the most susceptible animals without danger. Many efforts have been made to discover a practicable method for destroying this parasite without injuring the cattle, and the Bureau of Animal Industry has experimented for years with this object in view. Such treatment, if successful, would relieve most of the Southern cattle from quarantine restrictions, and would make these cattle bring more money in the markets of the country. After many failures, apparent success has been reached by dipping the cattle in the crude oil obtained from certain Texas wells. This oil is heavily charged with sulphur, and in the experiments so far made has not materially affected the cattle. It is necessary to regard such a treatment with some reserve until a large number of animals have been treated under the conditions which obtain in the practical shipment of cattle from the infected district to the markets; but it may be said now that this oil has been tried at the animal industry experiment station near Washington with entirely successful results, being distinctly superior to any other substance tested, and that it has also been tried in the field with about 70 head of cattle, the effect being equally favorable. Arrangements are now made for using the treatment on a much larger number of animals, and if, as hoped, no objections to it develop, it will be of inestimable value to the cattle industry of the Southern States.

HOG CHOLERA.

The losses from contagious disease among hogs in the United States have been enormous, probably reaching in some years the aggregate of $75,000,000, and being seldom less than $30,000,000. This Department has for a quarter of a century been conducting scientific experiments with a view to elucidating the nature of the disease and developing some practical treatment by which it might be controlled; and while much has been discovered as to the effects of certain bacilli, and as to the desirability of sanitary measures, no satisfactory method of controlling the disease has been evolved. Recently it has been shown by the Bureau of Animal Industry that there is, at least in some of the outbreaks, a different cause at work from what has heretofore been suspected. When the bacilli which have been supposed to cause the disease are all filtered from the blood, this liquid is still capable of producing the malady and has apparently the same degree of virulence as it had before filtering. It is yet too early to estimate the proportion of the losses attributed to hog cholera which are caused by this agent, which passes through the finest filters, and which in this condition must be too small to be revealed by the highest powers of the microscope. Investigations are now being made to throw some light upon this question; but enough is already known to make it probable that this discovery will prove of very great importance.

TUBERCULOSIS.

Investigations have been conducted with human and animal tuberculosis, with a view of determining whether the disease is transmissible from man to animals or from animals to man. It has been shown by the experiments which have been made that there are cases of human tuberculosis in which the bacilli are as virulent for cattle as are the bacilli obtained from animals affected with the disease. The conclusion from this fact is that either human and animal tuberculosis are identical and intercommunicable or the persons from whom these virulent bacilli were obtained had been infected with bovine tuberculosis. In either case, it must hereafter be admitted that the tuberculosis of animals is a menace to human health, and that both for economical and for sanitary reasons measures should be adopted for its control.

BLACKLEG.

The work against blackleg continues satisfactory. During the season the Bureau vaccine was used with 775,877 cattle, and the percentage of deaths after vaccination, not counting those animals that were evidently diseased before vaccination, was 0.53; whereas before vaccination the average percentage of losses among the same herds was 2.69.

INSPECTION OF ANIMALS AND ANIMAL PRODUCTS.

The number of certificates of inspection issued for American cattle exported to Europe was 960. The number of clearances of vessels carrying live stock was 634. The number of sheep inspected for export to Europe decreased from 211,224 in 1902 to 111,448 this year. The exports of horses fell off very considerably also, being 3,910 this year, as against 10,967 in 1902. Of the 228,365 cattle inspected for export, 226,613 went to Great Britain.

MEAT INSPECTION.

In the meat-inspection service the number of ante-mortem inspections was as follows: Cattle, 11,988,760; sheep, 14,654,249; calves, 1,041,138; hogs, 31,546,222; horses, 344; a total of all animals of

59,230,713. The following post-mortem inspections were also made: Cattle, 6,165,890; sheep, 8,598,175; calves, 670,173; hogs, 21,827,047; horses, 344—a total of 37,261,629.

The meat-inspection tag or label was placed upon 21,124,318 quarters, 362,689 pieces, and 186 sacks of beef; 8,571,643 carcasses of sheep; 667,259 carcasses of calves; 880,945 carcasses of hogs, and 696,279 sacks of pork.

The meat-inspection stamp was affixed to packages of meat products that had received the ordinary inspection, as follows: 7,520,854 of beef, 59,314 of mutton, 14,601,202 of pork, and 70 of horseflesh—a total of 22,181,440.

The number of cars sealed containing inspected meat products for shipment from official abattoirs and other places was 67,046.

The number of certificates of ordinary inspection issued for meat products for export, exclusive of horseflesh, was 30,152. Of beef, there were 1,388,633 quarters, 20,422 pieces, 401 bags, and 1,352,291 packages, with a weight of 371,920,737 pounds; of mutton, there were 35,394 carcasses and 22,527 packages, weighing 2,729,013 pounds; of pork, there were 24,380 carcasses and 506,311 packages, weighing 133,122,610 pounds.

The decrease in the certified exports of beef and pork, noted in the last report, continued, the figures showing a decline from the last year of 45,070,025 pounds of beef, and 55,237,401 pounds of pork. The exports of mutton were nearly two and a half times as much as last year, when there were 1,145,248 pounds certified.

There was one shipment of horseflesh, 70 packages, weighing 28,000 pounds.

The cost of the work of the ordinary meat inspection for the year was $711,546.18.

MICROSCOPICALLY INSPECTED PORK.

The exports of microscopically inspected pork to countries requiring inspection decreased 14,572,888 pounds—from 33,681,229 in 1902 to 19,108,341 in 1903. The cost of the microscopic inspection was $78,179.63, being an average of 16 cents for each examination, and for each pound exported 0.41 cent.

IMPORTS FROM MEXICO.

There were imported from Mexico 52,780 cattle, 4,119 sheep, 1,794 goats, and small numbers of other animals. At seacoast ports there were imported 2,602 horses and 169 ponies.

RENOVATED-BUTTER INSPECTION.

The inspection of dairy products under the act of March 2, 1902, was continued. Repeated inspections were made of 82 renovated-butter factories, located in 17 States, and the quantity of butter made by these was 54,656,800 pounds. This was an increase of 9 per cent over the previous year.

BUREAU OF PLANT INDUSTRY.

The work of the Bureau of Plant Industry has been pushed with vigor during the year. The advances made and the suggestions and recommendations for future work are set forth under the accompanying headings, and are believed, in all cases, to be for the betterment of agricultural conditions in the United States.

COOPERATION WITH THE EXPERIMENT STATIONS.

The Bureau is cooperating now with more than forty State experiment stations along many varied lines. The improvement of forage crop conditions, the extension of the work on cereals, the testing of new seeds and plants from home and abroad, demonstration work in the treatment of plant diseases, etc., are some of the more important problems upon which the stations are contributing to the Bureau.

THE DISTRIBUTION OF SEEDS AND PLANTS.

As set forth in my last report, a number of changes have been made in the securing and distributing of seed for Congressional purposes. Instead of contracting for all the seed and having it put up by one firm, the Department has purchased the seed and arranged for the putting of it up by contract. This is a great improvement over the old method, as it practically removes all opportunities for difficulties which have been encountered in the past in the matter of substituting inferior seeds for those called for, giving short weights, etc. With the enormous amount of seed that has to be purchased in the Congressional distribution, it is impossible to make provision in advance for everything that will be required. If seed were a fixed commodity it would not be difficult to make specific contracts for the delivery of particular quantities at particular times. So much, however, depends upon weather and other conditions that it can never be determined until the harvests are all over as to what seed can and what can not be obtained. For this reason it is not practicable, nor is it desirable, that the Department should endeavor to secure its seed by the ordinary contract system. Inferior seed can so easily be substituted for good that the Department must devote special attention to this phase of the subject in order that nothing but the best may go out.

To accomplish this, seed, for the most part, must be purchased in the open market from men who are known to be reliable and in whom dependence can be placed for furnishing seed according to contract. To protect the Department in all of its interests, inspectors are kept constantly in the field during the growing season looking after the crops that are being grown for the Department and in other ways keeping track of the seed conditions in general, so as to be intelligently guided in the matter of purchases. Furthermore, the Department, by judicious placing of orders for seed, can encourage home industries. This it is endeavoring to do in every case where it is practicable. In a number of instances, where certain kinds of seed are grown to a large extent abroad, the Department has placed its orders with American growers in order to encourage the work in this country. This is particularly the case with flower seed, of which a number of kinds are now being specially grown for the Department on the Pacific coast and elsewhere.

Carrying out the plan as set forth in my last report, special attention has been given to particular crops, such as cotton, forage plants, and other crops. In the matter of cottons an effort has been made to secure for general distribution varieties which have come to the attention of the Department's officers as valuable sorts, but of local distribution only. The work in this connection has been exceedingly valuable, and many reports have been received as to the greater usefulness of the varieties distributed over those locally grown. The same is true of a large number of forage crops. A particular effort has been made in the matter of distributing home-grown sugar-beet seed. It has been found that sugar-beet seed can be grown successfully in this country, and that the beets from such seed yield a high sugar content. Ten thousand pounds of such seed were distributed last year, and careful work was inaugurated to determine the value of the product from these seeds as compared with seed grown abroad.

With regard to the securing and distributing of miscellaneous garden and flower seed, the fact remains that this work does not accomplish the ends for which the law was originally framed. There are collected, put up, and distributed now, on Congressional orders, nearly 40,000,000 packets of miscellaneous vegetable and flower seeds each year. These seeds are the best that can be obtained in the market, but from the fact that large numbers of packets are wanted, the seed obtained can be of standard sorts only, such as are to be found everywhere for sale in the open market. As there is no practical object to be gained in distributing this kind of seed, it seems very desirable that some change be made. To this end, it would seem wise to limit our work entirely to the securing and distributing of seeds, plants, etc., of new and rare sorts. There is still much to be done in the way of securing seeds, plants, etc., of this kind from abroad, but still more to be accomplished in careful investigations of our own possibilities in this direction. There are many valuable plants scattered all over this country which are still little known outside of their respective localities. These should be collected, tested, and distributed. There are also great possibilities of improving agricultural industries by distributing specially bred seeds and plants.

As the plant-breeding work of the Department increases, opportunities for securing seed of this nature will accumulate. To do this work in the most effective manner, arrangements could be made in all cases to secure the advice and assistance of Senators and Representatives who have agricultural constituents. The Department has a well organized force of scientists who are thoroughly familiar with the general conditions of soil and climate in nearly all parts of the country. Special crops could be selected for special purposes, and with the advice and cooperation of Members of Congress such crops could be placed where they would do the most good. This is a line of work that would result in very much more value to individual districts throughout the country than the distribution of a large quantity of common varieties of garden seed, which have no particular merits so far as newness or promise are concerned. I shall inaugurate the coming year work along the lines here mentioned, and hope to receive the cooperation and aid of Congress in this matter.

NEW SEEDS AND PLANTS FROM ABROAD.

During the past year the seeds secured by our agents in Asia and Africa, to whose explorations reference was made in my last report, have been received and distributed. Special attention was paid this year to the reorganization of the work within the United States. It was felt that the time had come for more thorough work within this country, since there were many introductions that had not been pushed as they deserved to be. The clerical force was therefore strengthened, and a systematic attempt was made to secure reports from persons who had received seeds and plants. Many of these reports are now on file, and the work of compiling them to make them useful in further work is going on.

GRAINS.

Special attention has been given the grains. New wheats for the Northwest, new oats, new millets, and other crops have been pushed. The work on durum or macaroni wheats has been highly successful. Probably 10,000,000 bushels of this class of wheat were harvested in the crop of 1903. The value of macaroni wheats in the drier portions of the Great Plains is now fully established, and the demand for them is increasing as their value becomes better known. The quality of the wheats is always better in the drier areas, and in general they are not adapted to the ordinary spring and winter wheat districts. Where there is sufficient rainfall for good crops of spring and winter wheats, macaroni wheat should not be grown; especially as it is likely to be inferior in quality to such wheat grown in the drier regions, and could not, under such conditions, bring a price equal to that of the ordinary grades of spring and winter wheats or the better grades of macaroni wheat. There is a constant foreign market sufficient for a good export trade, as soon as the business can be facilitated by opening up the proper trade channels, but the home demand at the local mills is most important and is rapidly increasing. At least 20 mills are now handling this wheat, and there may be others not yet known to this Department. At an average capacity, these mills, running half time on macaroni wheat, would consume between 3,000,000 and 4,000,000 bushels during the year. A large part of the product is in the form of semolina, which is now being used by eight to ten of the most important macaroni factories in the country, all of which had formerly used ordinary bread flour, and a number of which will hereafter use only the semolina from macaroni wheat.

Tests have been made during the year, first by private institutions and some of the experiment stations, and then by the Department, to determine the value of macaroni wheat flour for bread. The results appear to show that a very good quality of bread can be made from such flour. After a number of preliminary experiments by the Department a test was finally made in which 200 loaves, made from macaroni wheat flour, were compared with an equal number made from the highest grade of spring wheat patent. Selected experts among the millers, bakers, flour inspectors, grain dealers, and teachers of domestic economy throughout the country stated their opinions in writing as to the relative merits of the two breads. A consensus of these opinions showed that in this experiment, at least, the macaroni flour made a fine quality of bread.

ALFALFA.

The Turkestan alfalfa seed secured by our agent in Asia was distributed through the active cooperation of Members of Congress. This distribution was made in such a way that it would result in a supply of home-grown seed being available in the future, so that we may avoid the expense and uncertainty attending the importation of the seed. Reports received up to date indicate that many of the plantings made have been successful, and there is reason to hope that this valuable variety has been permanently introduced into the United States.

Of especial importance will be the introduction of an alfalfa adapted to the alkali parts of our arid Southwest. Work on this problem has been pushed forward during the year. The seed secured by our explorer in Algeria, as well as some sent by our representative from Turkestan, has been planted under the personal supervision of the Department experts. There is reason to believe that this introduction will be successful, in which case it will be possible to reclaim large areas of land in the Southwest that are now too alkaline for alfalfa.

RICE.

The rice work done during the past year demonstrated the very important fact that by the use of proper varieties it is possible to materially extend the period of harvest. This has all along been one of the serious difficulties which the growers have had to encounter, but by the use of varieties which the Department has introduced it will be practicable to sow large tracts and to harvest as the different varieties ripen, without haste and without loss.

FLAX.

The cultivation of flax is one of the oldest agricultural industries in the United States, but it has been forced to move steadily westward to new lands, as it became unprofitable in the older States. It was thought that flax exhausted the soil and could thus only be grown for a few years in one locality, but recent research has shown that the real cause of "flax-sick" land is a disease, the germ of which, living over in the soil, soon makes it impossible to produce flax where this disease is prevalent. The importance of the industry to our Northwestern States may be judged when it is known that in 1901 the State of North Dakota alone produced $19,460,000 worth of flaxseed. To this must be added the growing industry of using the fiber of the seed flax for making binder twine and other coarse materials. This industry is seriously threatened by the same disease that has forced flax culture to move out of the Eastern States, and the Department has sent an expert to Europe in the hope that in some of the provinces of Russia a variety resistant to this disease might be found. In any event, it will be possible to secure better varieties than we now have and to learn how the farmers of Europe have managed to hold this disease in check.

NEW LINES OF WORK IN SEED AND PLANT INTRODUCTION.

Among several new introductions designed especially to meet the needs of the Southeast have been improved varieties of cassava, which gives promise of great value for stock-feeding purposes and starch making; superior varieties of mango for cultivation in the extreme South, and Mexican peaches and apricots which, it is thought, will be better adapted to cultivation in the South than the varieties we now have. A number of plants of a choice variety of pineapple were also received from South Africa through the generosity of Hon. Barbour Lathrop.

Work has also been begun on the establishment of the matting industry in the United States. At present matting to the value of nearly $5,000,000 is annually imported. A loom has been perfected for weaving the material, and the Department has undertaken the establishing of the cultivation of the raw material.

The Department annually receives many hundreds of packages of seeds and plants from abroad. These are all being carefully tested, and as fast as any give promise of value they will be propagated for further distribution.

The lines of work here enumerated are capable of great extension, and will result, as experience has already shown, in building up new industries of great importance to the country.

DRY-LAND AGRICULTURE.

Nearly one-third of the area of the United States has insufficient rainfall for the best culture of the ordinary crop plants. Considerable tracts of land are already irrigated and much more will be artificially watered in the future; but there must eventually remain enormous areas—doubtless nearly a fourth of the entire land surface of this country—which are doomed to remain perpetually in their present arid or semiarid condition for the want of an adequate supply of water for irrigation. The total rainfall over the lands lying between the one hundredth and one hundred and twentieth principal meridians is inadequate to irrigate more than a small fraction of the arable lands, no matter how carefully conserved and used. Dry farming is then a necessity, in order to utilize such lands where irrigation can never be practiced.

The Bureau of Plant Industry is occupying itself with the future of these regions, and is making a thorough study of the conditions and of the best ways and means of meeting them.

It is believed that not only can the grazing capacity of such lands be increased by intelligent management, but that large areas of such dry, but often extremely fertile, lands can ultimately be utilized for "dry farming." It is believed that as the irrigable lands become more and more completely occupied, there will be an increasing appreciation of the value of, and a greater effort to utilize, the dry, unirrigable lands adjoining settlements founded in the irrigated regions. In the meantime the scientists of this Department are endeavoring to secure plants that will grow in very dry soils, and at the same time yield paying crops that can be absorbed by our markets or profitably utilized on the farm. In order to carry out such introduction of new crops it is necessary to study most carefully the life history of each particular plant, in order to determine with some degree of accuracy its needs as to climate and soil, also its cultural requirements and the best methods of marketing or otherwise utilizing its products. It is only by carrying out in advance a life-history investigation in the most scientific way that it will be possible to introduce such new crops into profitable culture on a commercial scale without running the risk of most costly and discouraging failures.

To extend this important work a small increase in the appropriations has been included in the estimates of this Bureau.

NITROGEN-FIXING BACTERIA.

The fact that leguminous crops, like peas and clover, can obtain nitrogen directly from the atmosphere when certain bacteria are present on the roots has been known for a long time, and many attempts have been made to cultivate and use these bacteria in agricultural practice. Attention has been called in past reports to the progress the Department has made in investigating this problem. At the time of the last report the reason for the failure of former work from a practical standpoint, both in America and in Europe, had been determined, and a new, simple, cheap, and thoroughly satisfactory method of cultivating, distributing, and using these nitrogen-gathering organisms for all important crops had been perfected. During the past season the value of these bacteria has been demonstrated in extensive field tests. Good stands of clover and alfalfa, vetch, cowpeas, etc., have been secured in soils where, without the bacteria, these crops were a failure. The field work also demonstrated that soil and seed inoculation are equally valuable, so that either method may be used according to convenience. As a result of these experiments the Department is now prepared to furnish, in reasonable quantity, organisms for all the principal leguminous crops. Patents have been applied for, covering all the processes used, in order to make them secure for general public use. In order to enlarge the scope of this work and to carry on the necessary field demonstrations, an increase in the funds of the plant physiological and pathological investigations has been included in the estimates.

WATER CONTAMINATION BY ALGÆ.

It is well known that algæ of various kinds play an important part in the contamination of water supplies. The bad odors and tastes which some varieties of these plants give to water make it unpalatable to stock as well as to man. Some of the algæ also smother out aquatic crops, like cress, and furnish breeding places and food for mosquitoes. The physiologists of the Bureau of Plant Industry have now developed a cheap and effective method of exterminating algæ, which promises to be of universal application, in reservoirs, lakes, ponds, etc., where algal pollution exists. Extensive tests are now being carried out in cooperation with various board of health and water engineers, and the results so far have been extremely satisfactory. When the tests have been completed a full report will be issued and the method fully disclosed.

NEW LONG-STAPLE UPLAND COTTON.

Attention was called in the last report to the fact that the plant-breeding experts had secured some hybrid long-staple Upland cottons which promised to be of great value. These are of the ideal type desired, having large bolls, very productive, with long, fine fiber, about 1¼ and 1¾ inches, borne on smooth black seeds. Preliminary field tests of the varieties have now been completed, and several of the best appear to be already fixed in type and come true by seed. Extensive field tests are under way, and if the results of the present season's work are satisfactory seed will be grown for distribution. Much attention has also been given to the improvement of the ordinary

Upland types of cotton by straight selection. Many growers have become interested in this work, and appreciate the value and importance of careful selection of seed.

EGYPTIAN COTTON.

Another important line of work which is receiving considerable attention at the hands of the Physiologist and Pathologist is the introduction and establishment of the best varieties of Egyptian cotton. We now import annually about $7,500,000 worth of these cottons, and the demand is rapidly increasing. When first introduced, most of these varieties gave comparatively light yields, and in some cases the fiber apparently lost some of its essential characteristics. These difficulties, however, are gradually being overcome as the result of careful selection and breeding. Samples of fiber grown last year in experiment patches have been submitted to experts in this country and Europe, and several of them have been pronounced equal to the best Egyptian. Manufacturing tests are now in progress. The indications at the present stage of experiments favor the belief that we shall soon have varieties adapted to cultivation in this country. The tests are in progress in Georgia, South Carolina, Mississippi, Texas, New Mexico, Arizona, and southern California.

DISEASE-RESISTANT COTTONS.

Great interest has been manifested by planters and handlers of cotton in our work of securing disease-resistant strains or varieties. The wilt-resistant Sea-island varieties distributed by the Department last year and this year have proved highly satisfactory. Wilt-resistant Upland strains have now been developed and are being grown on a large scale this season for the production of seed. Growers in all parts of the cotton belt where wilt occurs have adopted the method of resistant-seed selection recommended by the Department. In infected land the ordinary sorts are a complete failure, while the resistant varieties produce a good crop. Considerable progress has also been made in selecting varieties resistant to Texas root rot, the boll-weevil, and other serious pests.

DISEASES OF SUGAR BEETS.

The work on sugar-beet diseases was continued during the year. The spraying experiments with Bordeaux mixture for the control of leaf blight were entirely satisfactory in holding the diseases in check, and resulted in an increase of approximately 50 per cent in the tonnage. Further investigations were also made of the disease known as curly top, which was prevalent last year and has been even more serious the present season. So far we have been unable to determine the cause of this malady, but there is hope of securing strains resistant to the disease. A small increase in the appropriations for this work has been put in my estimates.

DISEASES OF ORCHARD FRUITS.

The work on diseases of orchard fruits for the past year has been largely in the nature of demonstrative experiments, the idea being to show the practical growers how to put into operation the various methods of fighting disease. Especial attention has been given to little peach in Michigan and New York. In the former State, in cooperation with the State authorities, the disease has been stamped out of a large area. The principal work in pear blight has been carried on in Georgia. In the north Georgia experiments the treatment was entirely successful, the disease being eradicated from the experimental orchards. In the south Georgia experiments, while the disease was not completely eradicated, the treatment greatly improved the condition of the orchards as compared with the surrounding untreated orchards. From the large field experiments in the past two years the Department now feels certain that bacterial blight of pears and apples can be controlled if the treatment recommended by the Department is carried out thoroughly. Similar demonstrative work will be done in some other pear or apple section the coming season.

DISEASES OF TRUCK CROPS.

The intensive culture of vegetables for home and foreign markets has developed to great proportions in the United States. Wherever crops are grown on an extensive scale the appearance of a disease becomes a serious matter, and often the cause of great loss. In nearly every important truck section serious diseases have appeared, and wherever they have been called to the attention of the Department an effort has been made to determine the cause, and if possible to suggest a remedy. The loss to the cucumber growers in the South Atlantic trucking regions and in the Mississippi Valley was heavy this year, owing to the prevalence of bacterial wilt and downy mildew. Information was furnished to the growers relative to the means of controlling these two diseases. Considerable work was also done with watermelon, tomato, and cabbage wilt. The only way to control these wilt diseases is by the use of resistant varieties. In the case of the watermelon, the citron and some foreign melons have proved to be wilt-resistant, and hybrids between them and the native varieties were also resistant and immensely productive. An endeavor is being made to fix a type of these hybrids. We have also succeeded in obtaining resistant selections from American varieties. With tomato and cabbage a similar line of work has been started, with promise of success. Further tests of the variety of cowpeas known as "Little Iron," resistant to wilt and root knot, have been made during the year, and even in the worst infected soils this variety has proved perfectly resistant. It has been crossed with heavier yielding varieties, with the hope of obtaining improved strains.

CALIFORNIA VINE DISEASE.

Attention has been called from time to time to the progress that has been made in efforts to find a method of controlling the California vine disease, a malady the cause of which still remains unknown. Experiments with grafting stocks have been in progress in the center of the badly infected district for over eight years. These experiments have included the grafting of some 400 acres of vines, the enterprise being conducted in cooperation with leading viticulturists in California. The Lenoir vine is resistant to the disease, and its use either as a top graft or as a root upon which to graft other varieties has been found effectual in resisting the disease.

New varieties of grape, which have received Lenoir blood through hybridizing, have shown great resistance to the same disease.

So far as this experiment has gone, therefore, it seems probable that a satisfactory means of permanently overcoming the disease has been found.

TIMBER PRESERVATION AND SEASONING.

The work of timber preservation and seasoning has been conducted by the cooperation of the Bureau of Plant Industry and the Bureau of Forestry. The saving caused by improved methods of cutting timber to insure longer life has already been very great. In one instance about $50,000 was saved in six months. Extensive tests were carried on in cooperation with railway, telegraph, telephone, and mining companies, to determine the amount of water evaporated from timber. Drying out timber according to methods suggested by the Department has led to a great saving in freight and increased length of life of the timber, besides resulting in a saving of labor in handling it. Various preservative processes have been tested during the year, and considerable advance has been made in this art as the result of the Department's investigations. Our aim is to secure a process which will be so cheap and effective as to make it within the reach of even the small user of timber.

WORK WITH MUSHROOMS.

An industry of considerable importance has sprung up in this country in the growing of mushrooms for market; but so far it has not reached great proportions, owing to the fact that most of the spawn has to be imported. We also import in the shape of canned mushrooms about 2,300,000 pounds annually, principally from France. There is no reason why this important food plant should not be grown here to a sufficient extent to cover all our needs. One of the greatest difficulties of mushroom growers, both in this country and in Europe, has been the uncertainty of growing a productive spawn of high vitality, and so far practically only one variety of mushroom has been cultivated commercially. The Department has now discovered a simple and practical method by which we have produced a high grade of spawn, not only of the cultivated mushrooms, but of many of the wild sorts which it is desirable to cultivate. The perfection of a simple and effective method of propagation, as above stated, applicable to all varieties of mushrooms, is probably the most important step in mushroom culture that has ever been made.

DRUG AND MEDICINAL PLANTS.

The extensive importations of crude drugs, amounting to more than $3,000,000 annually, have led to many attempts to cultivate drug plants in this country. In most instances this work, entered into by persons who were without adequate information in regard to the conditions required, has resulted in discouragement and loss. Experiments undertaken by the Botanist to determine the actual cost of producing, curing, and preparing for market certain kinds of crude drugs, especially leaves of plants like stramonium, indicate that they can not be produced profitably unless they may be grown where land and labor are cheap, and where the growing season is long. An experiment in curing the leaves with artificial heat gave very promising results, and if this method proves to be entirely satisfactory a great saving in time and labor will be accomplished in this part of the work, with the assurance of greater uniformity in the product.

The cultivation of golden seal, seneca snakeroot, and other similar native drug plants that are becoming exterminated in the wild state, has been begun on a small scale, to secure definite knowledge in regard to their life habits and to determine the conditions under which they may be cultivated. Owing to the increasing demand for them and their rapid disappearance from the forests, their successful domestication is extremely desirable.

POISONOUS PLANTS.

The important results from the poisonous-plant investigations conducted by the Botanist in previous years have been followed by an increased demand for further work along this line. The annual loss of sheep from eating poisonous plants on the ranges of the Northwest has been estimated to exceed $400,000. There are also very considerable losses among cattle and horses on the Western ranges, due to death camas, loco weed, and other poisonous plants. Besides a large amount of miscellaneous work in this direction, with the accumulation of important information in regard to various kinds of poisonous plants, special investigations have been made with two important groups—death camas and the lupines.

The excellent lupine forage, which has been avoided by many stockmen because they lacked knowledge of the character of its poisonous properties, may be utilized, providing certain precautions are regarded. Sheep must not be allowed to eat freely of lupines when coming hungry and thirsty from a dry, barren range. Some other food, preferably of a succulent character, and a plentiful supply of water should be given to animals grazing on lupines.

FIBER PLANTS.

The importation of vegetable fibers amounts to more than $30,000,000 annually, and the quantity is continually increasing; yet it is scarcely sufficient to meet the demands of our increasing cordage and textile industries. There are areas in this country where soil and climatic conditions are as well suited to the growth of flax and hemp as anywhere in the world; yet nearly all of the flax fiber and more than half of the hemp fiber used in our manufactures is imported. To compete successfully with the foreign product, our farmers must produce a fiber of equal or superior quality at a relatively low cost. The first requisite for superior quality of fiber is an improved variety of the flax or hemp plant. With this object in view, seeds of improved foreign varieties are being imported, and selections of seed are being made from American-grown plants. Reduction in the cost of producing the fiber must be brought about mainly by the introduction of improved methods of handling the crops and the substitution of machinery for the large amount of skilled hand labor which has heretofore been regarded as necessary in the preparation of the fiber. Carefully conducted experiments are needed to demonstrate the practicability of new methods that will reduce the cost of production.

IMPROVEMENT IN MANILA FIBER.

Manila fiber is the strongest and most important material used in the manufacture of the better grades of cordage. With a greatly increased demand during the past five years, and consequent high prices, a tendency arose among Philippine producers of manila fiber to sacrifice quality for quantity. Importations showed carelessness in preparing and in grading the fiber, a condition that threatened serious injury to the market for this, the most important product of the Philippine Islands. After careful examination of the fiber in the bales as imported, a report was forwarded to the Philippine government, by whom immediate action was taken and a thorough investigation made of the production of manila fiber in the field and its preparation for export. A law has been drafted by the Philippine government regulating the methods of cleaning the fiber, and also to provide for inspection of fiber to be exported. The higher standard of quality and the uniformity of grade assured under this law will not only result in great satisfaction to the manufacturers and users of manila cordage, but it will tend to still further increase the market for this most useful fiber.

GRAIN-GRADING METHODS.

The inspection and grading of grain, which is a prominent feature of our grain business, has been the cause of some apparently well-founded dissatisfaction in both our domestic and foreign trade. The chief cause of this has been that grain inspectors have had, as a rule, no adequate means of educating their judgment, upon which they must rely for the greater part of their work, and the inspection departments have had no very satisfactory apparatus for settling disputed or appealed cases. During the past year the Department has developed an apparatus for determining the moisture content of grain, particularly corn. This apparatus, essentially an air bath and a delicate balance, enables any inspector or warehouseman to determine the condition and probable keeping quality of corn; since excessive moisture is the principal cause of deterioration in this cereal.

Methods of accurately measuring essential qualities and defects of any sample of grain are a necessary preliminary to a satisfactory system of grain grading. The Department is, therefore, endeavoring to learn what these essentials are for each class of grain and how they can best be measured, so that grain inspectors may have available the means to do their work with the highest possible degree of efficiency.

The general adoption of such methods is likely to be of great benefit to the grain trade, as it will naturally result in greater definiteness of rules for grades and more uniform work by inspection departments.

FOREIGN COMPARED WITH DOMESTIC CLOVER SEED.

For the past two years cooperative work has been carried on between the Bureau of Plant Industry and several of the agricultural experiment stations to determine the relative value of foreign and domestic red clover. The seed raised in this country has given a larger yield of hay, though one sample from Russia gives promise of a good yield in the northern tier of States. Experiments will be undertaken to determine the relative feeding values.

TYPE LOCALITIES AND CHANGE OF SEED.

The work done on foreign and domestic clovers shows that there is a marked effect on general thriftiness, yield, and earliness when seed from one locality is sown in another where it is subjected to different conditions of climate and soil. Under the present methods of handling in this country, the seed is all brought together at the large market centers, where it is bulked and graded according to appearance, without regard to place of growth. This seed is then distributed to the small dealers throughout the clover-growing area. While the indiscriminate mixture and change of seed resulting from this method of handling may prove beneficial in some cases, it is often undoubtedly a distinct disadvantage.

The seed of all of our grass and forage plants, as well as much of our vegetable and grain seed, is produced under similar conditions, thus preventing any knowledge of origin or special adaptability.

A thorough study should be made of our principal crops to determine the type or best locality for seed production, as well as the advantage or disadvantage of changing seed from one locality to another, and the limits within which this should be done.

A study should also be made of both the foreign and domestic seed production of the crops, of which we now import large quantities, so that the domestic production may be aided and encouraged as far as possible.

DEMONSTRATION WORK WITH FORAGE CROPS.

The office of Grass and Forage Plant Investigations has put in the field a number of agents, whose duty it is to visit farmers in sections where forage plants are needed and arrange with them to grow a small area of some crop which is known to be valuable in that section. In this way much interest has been created in crops which were new or comparatively so, particularly in the cotton-growing States. As a result of this work, there is now a decided movement toward a diversified system of farming.

In addition to the above, a number of small demonstration farms have been established, on which various grasses and forage plants are grown, under the direct supervision of officers of the Department. These farms are visited by large numbers of farmers who by this means acquire an interest in the crops and some knowledge concerning their cultivation and utilization. In other words, new and valuable crops are being rapidly introduced into many sections of the country where greater diversification of crops is needed.

WILD HAY.

In 1899, 15,457,000 acres of wild grasses were cut for hay in this country. During the present season the grasses thus utilized have been studied with a view to ascertaining their relative agricultural value. Much important information has been gained, and some of these grasses have been found which possess characteristics that will enable us to bring them into cultivation, particularly in the arid and semiarid regions of the West. We are now gathering considerable seed of four or five of the most important, with a view to introducing them on cultivated land.

LEGUMINOUS CROPS.

One of the most important movements which has occurred in American agriculture is now in progress. It is the general introduction of alfalfa as a hay and pasture crop. During the present season good crops of alfalfa have been grown by our experimenters in almost every State in the Union.

Other leguminous crops are receiving a large share of attention. The Department has secured some seventy-five varieties of soy beans, and has grown them for two seasons with a view to finding varieties adapted to different climatic conditions. Within another year we shall be ready to begin the introduction of a number of the best varieties. Varieties have been found adapted to practically all parts of the country.

The cowpea continues to receive a large share of attention in our demonstration work. We are attempting to add largely to the acreage of this important crop in the cotton States. Varieties have been secured adapted to the Northern States as well.

A number of new legumes have been secured and are being propagated with a view to obtaining seed for introduction work in the near future.

RANGE INVESTIGATIONS.

Fifty-eight square miles of typical range land near Tucson, Ariz., have been put under fence during the year. Careful studies are being carried forward on this area, with a view to determining the result of protecting the now exhausted range from the depredations of stock. In the State of Washington we have demonstrated that the mountain ranges may be restocked with grasses by using seed. Our investigations have also shown that the ranges in that section may be so handled as to largely increase their productive capacity; but in order to do this it is believed to be demonstrated that it is necessary for those who graze stock upon the ranges to control a definite area of range land.

SOIL AND SAND BINDERS.

A representative of the office of Grass and Forage Plant Investigations during the past season studied the extensive work on soil and sand binding that has been done in Europe. After two hundred years of experience in Europe it has been shown that drifting sand can be controlled. Work has been undertaken with this end in view at The Dalles, Oreg.; Astoria, Oreg.; on the eastern shore of Lake Michigan, and at several points on the Atlantic coast. In many places these drifting sands have covered up extensive areas of valuable farm land. In other cases they have encroached upon cities, and have even buried portions of them. In still others they have interfered seriously with railroad traffic.

CASSAVA.

Studies by agents of the Department have shown that the cassava crop is of great importance in the region adjacent to the Gulf as a feed for cattle and hogs. This crop has been grown in a desultory way in Florida for nearly half a century. The value of the crop has been known, but there have been two principal difficulties in the way of its cultivation. The first is that it is propagated from sections of the stalk, and these are very difficult to keep during the winter season. Growers have now been found who have apparently solved this difficulty, and a number of the best methods of keeping the seed stems will be tested on a large scale by the Department this winter.

The other difficulty relates to securing a stand. It has been demonstrated that it is practicable to sprout the cuttings in hotbeds and transplant them into the field afterwards, and in this manner to secure almost a perfect stand, thus doubling the average yield. Arrangements have been made to give this method a thorough trial next season. The importance of this work will be better understood when it is known that an acre of cassava yields as much food value as 8 to 10 acres of corn in the section where cassava is grown.

POMOLOGICAL INVESTIGATIONS.

In no other country in the world has fruit culture attained such large proportions as in the United States. Favored with a broad range of latitude, affording great variety of soil and climatic conditions, there are but few fruits of the temperate zone that are not now produced on a commercial scale within our borders. The track of the pioneer has everywhere been marked by the planting of orchards and vineyards.

In certain regions the production of fruits and their products has become the chief feature of agricultural life, and the welfare of the people therein is largely dependent upon the successful production, harvest, and sale of such fruits as the peach, apple, grape, orange, and several others. In all such regions the question of adaptability of types and varieties to soil and climatic conditions, and their suitability for the purposes for which they are to be used, becomes a most important one from the economic standpoint. Unlike the grower of grain or vegetables, the orchardist or vineyardist must invest years of time and labor, in addition to the original outlay for land and stock for planting, before his plantation attains sufficient age to begin to yield a return. It is therefore of the utmost importance that there should be accessible to him information regarding the distinct characteristics of fruit varieties, their particular requirements as to soils and climate, their times of ripening, and suitability for particular uses, such as shipment to distant markets, use in canning, drying, preserving, etc. One of the important duties of the Pomologist and the force engaged under him, is to accumulate and interpret the results of individual experience along these lines throughout the country, so that it may be furnished to the interested public in convenient form for their guidance in fruit culture.

FRUIT MARKETING AND STORAGE.

Some of the most pressing and important questions relating to the fruit industry are those that grow out of the present tendency in horticulture to produce each fruit in that section where it can be grown best or to mature at a certain desired time, even though that locality be thousands of miles from the market where the product will be consumed. These problems may be characterized as those relating to marketing and storage. Their solution lies at the foundation of development of important export trade in fruits, and is hardly of less moment in connection with that portion of the crop which is used at home.

Some of the questions involved are with regard to the best methods of harvesting, grading, packing, and transporting each fruit, with reference to accomplishing its safe and economical delivery at its desired destination; also with regard to the suitability of the variety, packing and package, to the needs of the consumers, who are to be the purchasers if profitable trade is to be built up. These questions are of especial importance in connection with the export trade, and a series of experimental shipments is being made to obtain light upon these points.

Through these experiments, which have been conducted on a commercial scale, chiefly through the ordinary channels of trade, it has been demonstrated that the Bartlett pear, a choice but perishable fruit, of which there is frequently so large a surplus in our Eastern States as to depress prices to a point where the producer receives little return for his labor, can be successfully and profitably shipped in refrigeration across the Atlantic and sold at prices that yield a good net advance over home value.

Elberta peaches from Georgia and Connecticut, and several varieties of summer apples from Delaware, can be landed in London in prime condition when the climatic conditions at time of shipment are favorable; and they are likely to meet with good demand at fair prices.

It is gratifying to note that commercial shippers are following the work of the Department along these lines with keen interest, and preparing to make extensive shipments of such fruits as are found capable of profitable handling in this way.

A notable event of the year was the inauguration of direct shipments of American winter apples to Paris through the instrumentality of the Department. As was anticipated from previous investigations made by the Department, russet varieties were found to have preference to red apples in that market, and where sound and free from blemish were in good demand at high prices. The opportunity to develop trade in this line appears excellent.

Numerous and comprehensive tests of other fruits are under way, and may be expected to yield decisive results in due time.

The storage of fruits at low temperatures to retard their ripening and decay for a sufficient time to permit them to be handled to the mutual advantage of the grower and the consumer has assumed very large proportions in this country, chiefly within the past decade. It has been demonstrated beyond question that all fruits destined for preservation in cold storage should be stored quickly after removal from the tree; a uniform temperature of 32° retards the ripening processes of apples, pears, and peaches more than higher temperatures, without any noticeable injurious effect upon their flavor. It has also been demonstrated that certain delicate fruits, like the Bartlett pear and the peach, which ripen in hot weather, require quick cooling after entering the storage room, and that this can probably best be accomplished by storing in small rather than large packages.

STUDIES OF GRAPES AND GRAPE GROWING.

In addition to continuing the work of thoroughly testing the large number of varieties of European table grapes in the cooperative experimental vineyards in North Carolina and Florida, a comprehensive investigation of certain viticultural problems relating to the vine industry of the Pacific coast has been started.

The rapid and extensive development of grape culture in California is one of the most striking features of our fruit industry. Based almost exclusively upon the European grape species, as it is, vineyard methods modeled after those of the Old World are more successful there than in the vineyard regions of the Eastern States, where the native species of grape are the main dependence. The fertile soil and favorable climatic conditions in California have in general resulted in large yields and good profits to the grower.

Certain serious difficulties have arisen, however, which require immediate attention. Among these may be mentioned the general infestation of the important vineyard sections with the destructive Phylloxera, which preys upon the roots of the European grape. The general principles of the method of combating this insect through the use of resistant stocks have been demonstrated by entomologists, but the practical application of these involves many important vineyard problems which properly fall to the viticulturist. Among the most important of these is the relative adaptability of the known resistant stocks to the leading vineyard soil types and the congeniality of the principal commercial varieties of foreign grapes to these resistant stocks.

In cooperation with the California Agricultural Experiment Station and the office of Seed and Plant Introduction of the Bureau, experimental vineyards have been established at Fresno and Oakville in connection with this work.

WORK AT THE ARLINGTON FARM.

APPLES AND PEACHES IN NURSERY.

There are now growing in the nursery some 400 varieties of apples, the scions of which have been secured from bearing trees known to be true to name. The peach list embraces 150 sorts chosen with equal care. These collections have been carefully selected to represent the sorts now commercially grown in the several important apple-growing regions of the United States, together with a carefully chosen collection of varieties which show promise of becoming additions to the commercial list.

The aim of these plantations is that they shall form a basis for the comparative study of varieties when grown under like conditions, in order that the influence of climate on horticultural varieties may be observed, to afford basis for taxonomic studies upon cultivated varieties, and to furnish fresh fruits for comparative studies and identification of varieties, as well as material for further extending physiological studies upon the keeping of fresh fruits in artificial storage.

ORNAMENTAL TREES IN NURSERY.

The nursery at present contains several thousand seedling oaks, ashes, and maples, which have been grown from seeds gathered from trees of note in the District of Columbia. These trees, if sent to schools, parks, and other outdoor improvement organizations of the country, will prove objects of interest, and will be appreciated because of the sentiment attaching to the place of their origin.

EXPERIMENTAL FRUIT PLANTATION.

A further fruit plantation upon the Arlington Farm, consisting of 1,000 trees, is designed as a basis for studying the physiological action of the various insecticides and fungicides upon the health and longevity of trees.

CRANBERRY PLANTATION.

A small typical cranberry plantation is being established upon the farm, in order to determine the adaptability of the plant to the climate and the lowlands lying along the streams of eastern Virginia and Maryland. There are many thousands of acres of land now lying idle that might be made remunerative by the introduction of this crop if it proves suited to the conditions.

ARBORETUM.

An area of some 30 acres adjacent to the buildings which are in course of construction upon the farm is being prepared as an arboretum, in which will be arranged in an instructive, as well as artistic, manner all the native and exotic trees and shrubs which can be grown here. One of the chief reasons for beginning this line of work upon the Arlington Farm is that in this latitude there is an overlapping of the Northern and Southern floras of the United States, which allows the successful growing of a much greater range of species than can be cultivated either farther north or south.

THE POTOMAC FLATS TESTING GARDEN.

SWEET POTATOES.

An extensive variety collection of sweet potatoes is being grown on the Potomac Flats area. In fact, all of the commercial forms and types of the plant known have been assembled and are being raised, both upon the sandy soil of the flats and upon the clay loam of the Arlington Farm; also at one station in Alabama, one in New York, and three in Ohio, selected to cover the glacial drift soil of Ohio, the glacial drift of New York, and the prairie soil and alluvial river deposit soil of Ohio. The variety collection is designed to afford an opportunity for taxonomic studies, while the growing of the crop upon various soils is intended to give an idea of the influence of soil conditions upon the development and culinary properties of the root.

CELERY.

Celery is receiving special attention. It is being grown under various soil and moisture conditions, from various dates of seed sowing, and under the influence of various commercial fertilizers, in order to learn, if possible, the particular factor in environment which determines pithiness, if it is a question of environment rather than an inherited tendency transmitted by the seed of certain strains and varieties.

EFFECTS OF SHADE ON CROPS.

The physiological effects of shade are so marked and are of such commercial value that the horticultural work of the Department will be extended to cover a test of all truck crops which offer any advantages from being grown in shade. The work of the present season has been largely confined to the use of cloth and slat shades upon celery, cauliflower, lettuce, cucumbers, and radishes. As rapidly as the facilities of the Department will permit, all the truck plants which are grown for leaf production will be submitted to the influence of shade. In connection with this work the atmospheric and soil conditions will be carefully studied, with the hope that the reason why plants behave in a different manner under shade from what they do in the open may be determined.

BEET-SUGAR INDUSTRY.

The beet-sugar industry is developing satisfactorily. In 1896 29,220 tons were made; one year ago 220,000 tons were made. Careful estimates put the crop now being worked up at 260,000 tons. This is a more rapid development than has taken place in sugar making with new conditions in any other country. The future of the crop depends upon the adoption of economic methods in field and factory. The growing of seed in the United States of a superior quality is assured, which will result in much richer beets and better yields than from imported seed that is never first class. Heavier tonnage per acre will come from better farming, and more economy from intelligent disposition of the by-products. The industry is well established.

TEA-CULTURE INVESTIGATIONS.

During the year the work on growing tea has been continued at Summerville, S. C., and a new station has been put in operation at Pierce, Tex. At Summerville further work has been carried on in the testing of new varieties, new machinery, and new factory methods. The work at this point has now reached a state where more attention can be given to the improvement of the teas after being harvested. To this end a number of physiological and chemical studies have been made of the product at different stages with a view to improving methods of curing and increasing the flavors and aromas of the teas. The new methods and apparatus introduced by Dr. Charles U. Shepard, and used in the manufacture of green teas, have proved most satisfactory. Experiments have been carried on quite successfully in the preparation of tea tablets. These tablets are prepared in a special machine of great power, the result being a firm, polished product, which readily falls apart in boiling water. Improvements have been made in the matter of polishing and finishing the teas, all of which will add value to the American product. Despite the fact that the season has been a very unsatisfactory one for a number of reasons, the yield of tea will probably approximate 9,000 pounds, or about what was raised last year. A favorable season would have given a much larger production.

At Pierce, Tex., cooperative arrangements have been made with Mr. A. P. Borden, who has placed at the disposal of the Department a large tract of land suitable for tea growing, and has arranged to provide buildings and a portion of the labor. The Department has an experienced man located at this station, and is making preparations to put out at least 50 acres of tea the present autumn. It is planned to set out at Pierce at least 100 acres and extend the plantation as the funds permit. The labor question plays an important part in this work, but it is believed that conditions are such in southern Texas that proper labor can be secured without difficulty. Altogether, the tea investigations are in quite a satisfactory condition.

FARM MANAGEMENT.

In my last report I pointed out the work the Department was inaugurating in the matter of farm management. It was there shown that efforts were being made to bring together certain facts relative to the methods of managing farms in certain typical sections of the country, the object being to use this information in improving agricultural conditions where the best processes had not been followed. There is a great deal of valuable work to do in this connection, and there is no question that systematic studies along this line will greatly aid in the advancement of agriculture. In every community and in every section there will be found farmers who are much more successful than others. There are reasons for this, and it is these reasons that the Department is endeavoring to determine, so as to point the way for others to follow along the same successful lines.

Closely associated with this work are the demonstration experiments which the Bureau of Plant Industry is conducting. These have for their object the demonstration of the value of certain crops and certain methods over those which may be in use or existing at the present time. As an example of this kind of work, may be cited what is being accomplished in the introduction of alfalfa and other important forage crops into the South and sections of the country where such crops have not already been grown.

BUREAU OF FORESTRY.

The object for which the Bureau of Forestry exists is first of all to secure the highest permanent usefulness of the forests in the present and future interests of the country. Among our great industries, the lumber industry now stands fourth in importance.

Lumbering of the forests now standing must go on to supply immediate needs. This has made it necessary to find how to make conservative lumbering profitable, and the great danger has been that the rising price and growing scarcity of lumber would not of themselves bring this about until none but inferior forests should be left on which to practice forest management.

It is a safe assertion, that the lumber interests of the United States recognize to-day as never before that forestry has for them a practical commercial value; that the way is in many cases already open to them to consider conservative lumbering as a definite business proposition; and that this condition has been brought about entirely by the efforts of the Bureau of Forestry to deal with the concrete facts of a problem of National importance. The evidence of its success is not only the cases in which lumber companies have already begun to put into operation its plans, prescribing for particular tracts how to lumber with reference to future production, nor the applications which have been made for similar advice elsewhere, but to the surprising interest in the subject which has lately been evidenced among lumbermen generally.

It is greatly to be hoped that the Bureau of Forestry may not be compelled to let slip this opportunity for an important public service by inability to answer the demands which will be made upon it. Experience has shown its capacity to do this work. The wide knowledge of forest conditions and of methods of operation which it has gathered, and the organization which it has developed, fit it to undertake new problems with a probability of success which can be looked for in no other quarter. In so vast a country as ours, and under forest and economic conditions of such variety, the task of revolutionizing the long-established methods of an industry like the lumber business is one of enormous difficulty. On the ability of the Bureau of Forestry to demonstrate, as fast as opportunity permits, that it is good business for lumbermen to conduct operations with reference to future crops, depends in large measure the success or failure of the attempt to preserve what should be our chief sources of timber supply. The proper equipment of the Bureau for this work is nothing less than a National duty, and I have recommended that the annual appropriation for its use be substantially increased.

ADVANTAGES OF COOPERATION WITH PRIVATE OWNERS.

In cooperating with private owners the Bureau is not expending public money to benefit private interests. Scientific forestry—that is, enlightened management based on an accurate forecast of what a forest can be made to produce in the future—is impossible without full knowledge of all the forces, natural and artificial, which affect its productiveness. This involves a careful study of lumbering methods on the one hand and of the forest itself on the other. The Bureau has now in its possession as the result of this cooperative work the tabulated results of studies in many States from Maine to California and from Florida to Washington, representing a total of recorded individual measurements in the forest, the number of which would mount to scores of millions.

This vast mass of material has been gathered mainly at the private expense of the owners, who have received the expert assistance of the Bureau. Its possession makes it possible continually to enlarge the field of forestry. It has been secured by making its accumulation go hand in hand with practical results. Every working plan prepared and put in operation has meant both the preservation of a source of National wealth and an addition to the knowledge necessary for the wise use of the public as well as the private forests of the land.

Two considerations must be urged in connection with present conditions. The first is that cooperation is now supplying the Bureau with what it needs for Government work at a less cost than would be required to secure the same result independently. The second is that the speedy introduction of management on private lands is a matter of pressing importance. Forest preservation is necessary in the interest of the public welfare. Forest destruction on a large scale is now in progress. It can be checked only by showing that it is possible to use the forests without destroying them. The Bureau of

Forestry is doing this, and there is no other agency which can do it. If the Bureau does not put forth every endeavor to introduce conservative management among private owners, the public interest will suffer.

While it is true that hitherto virtually everything that has been done in this country to introduce conservative management as a paying business has been done by the Bureau, it is far from my wish that the Bureau should continue to control operations for private owners any longer than there is a clear and imperative need. It has already entered on the policy of detaching from its staff competent men to take charge of private operations when called upon to do so, in spite of the fact that it needs the services in its own work of all the trained foresters it has as yet been able to secure. The Government service, however, is the natural goal toward which most ambitious students of forestry will strive because of the superior opportunities of training which it affords.

SCIENTIFIC INVESTIGATION OF FOREST PROBLEMS.

There is danger that the attention which the work of the Bureau in promoting the actual management of forests naturally receives may obscure the importance of the investigations which it is conducting along other lines. These investigations are largely scientific in scope and method, but always entirely practical in purpose and outcome. The Bureau is the recognized source of information for the country on all forest subjects. The volume of its great and growing correspondence due to this is one evidence of its usefulness. It is conducting experiments along lines which have received the enthusiastic approval of engineers, constructors, and the like, to determine the strength of timbers. It is discovering how to treat cheap woods with preservatives so as to make it commercially practicable to substitute them for more expensive kinds, thus virtually adding new sources of valuable supply. It has inaugurated a new method of gathering crude turpentine which has revolutionized within a single year the naval stores industry of the United States, with an annual output of $13,000,000 worth of turpentine and rosin, whereby the yield of turpentine is nearly doubled with practically the same expense for labor, and the life of the tree which yields the turpentine is greatly prolonged.

In the fall of 1902 this new system had been experimentally in commercial use for a single season on the tract of one operator in Georgia. To-day the men who conduct three-fourths of the operations in the whole Southern pine belt have adopted it, or are waiting to adopt it as soon as their orders for the necessary apparatus can be filled.

FOREST MANAGEMENT.

While the growing willingness of the private owners, in whose hands are the great bulk of the forests of the country, to inquire into the possibilities of forestry in connection with their holdings has opened an opportunity for educational work, the value of which it is hardly possible to overstate, a larger proportion of the energies of the Bureau has been given during the past year to introducing forestry on public lands than ever before.

In accordance with the provisions of the so-called Morris bill, selection has been made and approved of 104,159 acres out of a total of 225,000 acres of land in the Chippewa Indian reservations in northern Minnesota, which will constitute the Minnesota National Forest Reserve. Official announcement of the second selection will soon be made. Selection of ten sections to be reserved from sale and settlement has also been made and approved. Volume tables and estimates of the total stand of the forest have been prepared, upon which will be based recommendations for the reservation from lumbering of 5 per cent of the timber for seed trees, as the act provides. Trees which will not be cut when the forest is lumbered have been marked on more than 6,000 acres, and rules which will control the lumbering have been prepared and have been approved by the Secretary of the Interior.

A working plan for the tract of the United States Military Academy at West Point was prepared at the request of the Secretary of War. The forest, which consists of hardwood sprouts, is in poor condition, the result of numerous fires and injudicious cutting. The plan is accompanied by forest maps, which show the location and area of the various types of forest, and provides for fire protection and for such improvement cuttings as will again put the forest in a sound and healthy condition. This plan is now being put into effect under the supervision of the Bureau of Forestry.

At the request of the Secretary of the Interior working plans were prepared for three Indian reservations in Wisconsin, which include recommendations for their protection from fire and rules under which they shall be lumbered without unnecessary damage to the forest.

ADVICE FOR PRIVATE OWNERS.

Ninety-four applications for assistance in managing forest lands were made by private owners. Of these applications 37 were for timber tracts and 57 for wood lots. Since the Bureau put into effect its cooperative scheme of assisting private owners, applications have been received for advice in the management of 5,656,171 acres. Farmers and other private owners of small tracts of woodland throughout the Northeast, the Middle West, and the South Atlantic States have applied in increasing numbers for the assistance of the Bureau in the management of their tracts. Fifty-eight working plans for wood lots were prepared last year.

STUDIES AND WORKING PLANS.

Field studies of five large timber tracts were made as follows: On 39,000 acres in Berkeley County, S. C.; on 2,321 acres on the Susquehanna River above Harrisburg, Pa.; on 16,000 acres in Mitchell, Caldwell, and Watauga counties, N. C.; on a Longleaf Pine forest in southeastern Texas, involving field work on 300,000 acres, which occupied 35 men for four months; and on 125,000 acres in northwestern Maine, which occupied 32 men for three and a half months.

Working plans are in preparation for the following tracts: A forest of 25,000 acres in Sullivan County, N. H.; a forest of 50,000 acres in West Virginia; and a forest of 3,000 acres in Grafton County, N. H.

The forest of R. C. Neal, near Harrisburg, Pa., for which a working plan was prepared last year, is now under conservative forest management. Two field assistants of the Bureau are supervising the lumbering operations of a large company in Newton and Jasper counties, Tex. The working plan for the United States Military Academy at West Point is now in operation. Twenty-seven wood lots in the Northeast and South Atlantic States are being managed in accordance with the recommendations of the Bureau. The first selection of the Minnesota National Forest Reserve, consisting of 104,459 acres, is now under the Bureau's supervision. In addition to these lands, 679,194 acres of private lands and 106,759 acres of public lands not included in forest reserves are under forest management.

The interest which large railroad companies have recently exhibited in the practice of forestry is one of the most encouraging developments of the year. Many of them have made application to the Bureau for its cooperation in studies whose results would determine the advisability of the purchase and management of forest lands for the production of railroad ties and other timbers. Forest work for railroads offers very great opportunities for useful work.

Cooperative studies of State forest conditions, in which the States shared in the expense of the work, were made for Maine, New Hampshire, and California. In Maine the forests of Piscataquis County, south of Moosehead Lake, were studied. The results of the work were presented in the Fourth Report of the Forest Commissioner of that State. In New Hampshire a study of the forests of the entire State was begun, with the purpose of determining the methods by which they may best be preserved. In California the work was directed toward the making of a forest map of the State, the determination of practical modifications in lumbering methods, and of the effects of grazing and fire, and other matters entering into the determination of a State forest policy.

Studies were made of the Sugar Pine in California, the Lodgepole Pine in Montana, commercial hard woods in West Virginia, North Carolina, Tennessee, and Kentucky, the Balsam in the Adirondacks, the Chestnut in southern Maryland, and the Red Pine in northern Minnesota.

The section of Forest Measurements, without increase of force, accomplished nearly twice as much work as in the previous year.

WORK FOR THE COMING YEAR.

The work of the section of Forest Management for the ensuing year includes more important undertakings than ever before. Technical problems involved in the management of the National forest reserves must be solved; the field work in Texas, in South Carolina, and in Alabama must be completed. Much work remains to be done on wood lots for private owners. On the lands to be included in the Minnesota National Forest Reserve those trees must be marked which are to be reserved in the lumbering, and supervision of the lumbering operations must be exercised by the Bureau. The study of the forests of California and of New Hampshire remains to be completed, and a study of Vermont forests will be undertaken. Commercial tree studies will be made in Maine, Minnesota, and the Southern States.

FOREST INVESTIGATION.

A notable accomplishment in the South during the year has been the extensive introduction of the cup and gutter system of extracting turpentine. This system, invented by Dr. Charles H. Herty, working under the Bureau's direction, although in operation only a year, is rapidly replacing the old, destructive system of boxing trees. Its great superiority is due to the fact that it is far less destructive than the box and that it yields at least 40 per cent more turpentine.

INVESTIGATIONS IN 1903.

Forest investigations were carried on in the following States:

In Maryland, a study of the distribution of the forests of St. Mary, Prince George, and Kent counties, in cooperation with the State Geological Survey.

In Texas, a study of the forest growth of the Edwards Plateau and its influence on stream flow.

In Missouri, a study of the swamp forests, including such timbers as Bald Cypress, and Red, Black, and Cotton gums.

In California, a study of the Tan-bark Oak in connection with the tan-bark industry.

In Ohio, Iowa, Michigan, and Montana, a study of forest distribution.

An investigation of the cedar-shingle industry was carried on in the Pacific Northwest, which included a study of the supplies of shingle cedar, the rate of consumption, etc.

The dendro-chemical laboratory, which was conducted in cooperation with the Bureau of Chemistry, obtained much valuable information in its study of gums and resins, the production of tannins, the use of different woods for pulp manufacture, the effects of poisonous chemicals on the life of trees, and the detection of adulterants in turpentine.

The life history of various insects harmful to trees in the East, South, and West was studied by the division of Forest Entomology in cooperation with the Bureau. It has been estimated that insects destroy every year $100,000,000 worth of timber. Experiments were carried on in methods of lessening this great damage.

Studies were made of the basket-willow industry and of the maple-sugar industry, and bulletins on both subjects are now in preparation.

WORK IN PROSPECT.

Work in forest investigations for the ensuing year will include—

Bulletins containing descriptions of the trees of the Northeastern, Southeastern, Rocky Mountain, Southwestern, and Pacific slope regions.

An attempt to clear up the confusion in the common names of trees.

A study of forest distribution in two counties of Maryland.

Special studies of forest distribution in Missouri and Arkansas.

A study of the Big Tree of California; of the acacias of the Southwest; and of the uses, structure, and characteristics of various American timbers.

Further experiments in turpentine orcharding under the cup and gutter system, to determine the minimum wound which it is necessary to inflict on the tree, the forest conditions which make for the highest productiveness, and the like.

A forest exhibit at the World's Fair, St. Louis.

FOREST EXTENSION.

Plans for tree planting were made for 68 applicants in 29 States. These plans, which involved the examination of 40,557 acres of land, were made in accordance with the cooperative plan inaugurated by the Bureau. Most of the plans were for farm wood lots of not more than 10 to 20 acres, but there were several notable exceptions. A plan was prepared for 108 acres on the Presidio Military Reservation of San Francisco. Planting plans were prepared for the grounds of the State institutions of North Dakota, at the request of Governor White. Other plans were prepared for farmers in the prairie regions along the Fort Worth and Denver City Railroad at the request of that company, and more than 600,000 trees were set out.

A planting plan was prepared for 640 acres in Cullman County, Ala., formerly covered by Longleaf and Shortleaf Pine. It was recommended that Loblolly Pine and White Oak, Post Oak, and Chestnut be planted on the land.

Men applying for planting plans show everywhere a disposition to follow the recommendations of the Bureau. Planting plans previously made are being carried out with encouraging prospects of success.

Tree planting continues on the Dismal River Forest Reserve of Nebraska and the San Gabriel Forest Reserve of California. The boundaries of the Dismal River Reserve have been surveyed and marked. Eighty acres of bottom land adjoining the reserve have been fenced, and part of the land converted into a tree nursery with space for the growing of 2,000,000 plants. Many thousands of Western Yellow Pine and Jack Pine seedlings were collected in the Black Hills and in Minnesota for planting in the Dismal River Reserve. On the San Gabriel Reserve much experimental planting was done on widely scattered areas. The planting was done mostly with pine seeds in seed spots. The total cost averaged $7.41 per acre.

The natural reproduction of deficient forests has been studied among the hardwoods of Oklahoma, the Western Yellow Pine on the Prescott Reserve of Arizona, and the White Pine on the abandoned fields and pastures of New England.

A very important branch of the Bureau's work is the study of forest fires, with a view to discovering practicable means of reducing the immense losses due to this cause. The year covered by the present report was characterized by fires of extraordinary severity both in the East and in the West. The investigation of those which occurred in the East in the spring and early summer of 1903, however, was not begun in time to fall within the scope of the present report. The great forest fires of September, 1902, in Washington and Oregon were the subject of a special investigation by the Bureau, which discovered a total loss estimated at $12,767,100. The Bureau's investigation showed that most of the destruction was due to carelessness and might easily have been avoided. Forest fires were studied also in Georgia, Florida, and the Lake States, with a view to discovering their causes, methods of prevention, and the total amount of damage they do.

Examinations of the Atlantic Coast and Columbia River sand dunes were made in order that methods of tree planting might be discovered to restrain the encroachments of the shifting sands. Tree-planting plans for sand-dune regions on the Atlantic coast are in preparation, and a strip of sand-dune land in Oregon has been withdrawn for experiment.

Work for the ensuing year will include:

A continuation of cooperative work in tree planting among private owners.

Tree planting on Pikes Peak, Wichita, Prescott, and San Bernardino forest reserves.

Improvement of natural reproduction on Pikes Peak Reserve and on lands in northern New Mexico.

Extension of the timber belts of Kansas.

A study of the methods of restocking cut-over pine lands in southern Michigan.

A continuation of the study of second-growth White Pine in New England.

A cooperative study with the State of California in improving the stands of timber.

A study of the Eucalypts.

The suppression of forest fires and the reclamation of shifting sands will continue to receive the attention of the Bureau.

FOREST PRODUCTS.

A work of great scope and importance undertaken by the Bureau is the determination of the strength and durability of the merchantable timbers of the United States. The investigation consists of tests of timbers performed in cooperation with the Bureau of Chemistry. The work is directed toward the solution of practical problems of interest to engineers, and has been approved by many prominent engineers, manufacturers, and lumbermen. These tests are being conducted in laboratories at Washington, New Haven, Conn., and Berkeley, Cal., on Red Fir, Western Hemlock, and Longleaf and Loblolly Pine.

Wood preservation forms a most valuable feature of the work of the Bureau. Railroad companies have eagerly followed the results of this work, since it has so important a bearing on their interests. The work consists in experiments in methods of seasoning and preserving construction, railroad, and other timbers so as to increase their strength and their lasting powers. A special feature of the work which gives great promise of success is the experiments with cheap substitutes for valuable woods used for railroad ties. Such work has been done with the Lodgepole Pine in Montana, with gums, birches, and inferior oaks in Pennsylvania, Kentucky, Arkansas, and Mississippi, and with Loblolly and Shortleaf Pine in Texas. Methods of seasoning Chestnut poles were studies in cooperation with the American Telegraph and Telephone Company.

Examinations and reports dealing with technical problems in the management of forest reserves have been made for reserves in Utah, California, Oregon, and New Mexico. Twenty-nine agents of the Bureau this summer examined more than 20,000,000 acres proposed as forest reserves in the Rocky Mountain and Pacific coast States.

FORESTRY RECORDS.

Extensive improvements have been made in the equipment of the forest library. Many books, pamphlets, and clippings have been added, and the whole library has been completely classified and indexed. The collection of photographs has been increased by 3,417 views, taken in 41 States and Territories and in many foreign countries. The mailing list of the Bureau has increased by 75 per cent. Eighteen new publications were sent out, of which 237,000 copies were printed. Besides these, 23 press bulletins and reprints of 14 publications were issued.

BUREAU OF CHEMISTRY.

NEW INVESTIGATIONS.

EFFECT OF PRESERVATIVES AND COLORING MATTER UPON HEALTH.

As numerous experts of high character have declared both for and against the wholesomeness of many common food preservatives, and as the law authorizes the Secretary of the Treasury to exclude from the country food products to which any injurious substance has been added, the necessity for an investigation of these differences of opinion and the establishment of a wise and just conclusion in regard to them is apparent. To this end, as well as for the information of the public, an elaborate series of experiments has been inaugurated. It is evident, in view of the work previously done in this line, that neither mere theorizing on the chemical and physical properties of preservatives and coloring matter nor experiments upon other animals than man can lead to definite results. With this in mind an experiment was developed as follows:

Twelve young men, who responded to a request for volunteers, pledged themselves to use no other food or drink than that provided for them, with the exception of water, any water not used at the table to be measured and reported daily; to continue to be for at least six months members of the "hygienic table," and during this time to observe implicitly all rules as to diet, exercise, smoking, etc., laid down for them by the Chemist.

A period of rest was effected by placing six of the men at the observation table and the other six at the recreation table alternately throughout the period of seven months. Each experimental period varied from thirty to forty days, and was divided into a "fore period" of ten days, during which a standard ration for each man was determined; a "middle period" of from ten to fifteen days, during which time each member ate the ration previously determined, together with the added preservatives, which in this experiment were borax and boracic acid; and an "after period" in which the same ration was continued, but the preservative withdrawn, the object being to restore the body to its normal weight in case it had been disturbed by the preservative.

A daily record was made on blanks furnished each member of the table of the following data: Weight, pulse, temperature, all data connected with the income and outgo of the food, and an account of all the foods taken and the meals at which they were eaten.

By analysis it was possible to determine just what part of the food was consumed in the production of heat and energy within the system, provided the weight remained constant. Furthermore, any failure on the part of the individual to observe the pledge to partake of no food or drink except what was served at the hygienic table would have been at once disclosed by a disturbance of the balance sheet.

Such in brief was the nature of the experiment conducted. The mass of analytical data obtained is now in the hands of the calculators, and these data, together with such conclusions as an unprejudiced judgment would approve, will shortly be published. The recording of the facts as they occurred and the tabulation of the figures in the most scientific manner possible will present to experts a basis for conclusions. The experiment is to be continued, taking up the most important preservatives in turn, salicylic acid being the next to be considered.

INSPECTION OF IMPORTED FOODS.

Looking to the enforcement of the pure-food law, enacted March 3, 1903, and going into effect July 1 following, preliminary arrangements were made with the Secretary of the Treasury and the Secretary of State by which their active cooperation was secured. The Secretary of State issued directions to the United States consuls that special declarations concerning imported foods be made and forwarded to the Secretary of Agriculture, and through the Treasury Department the collectors of customs at the leading ports in the United States were instructed as to the steps necessary to be taken in sampling such cargoes as might be detained for examination and the reshipping or destruction of such shipments as might, upon analysis, be excluded from the country under the terms of the act.

TABLE SIRUP FROM ORDINARY SUGAR-PRODUCING PLANTS.

The investigations previously made in the Division of Chemistry, and the testimony submitted before the committees of the House and Senate charged with the investigation of the adulteration of food products, show that table sirups are generally adulterated in a degree corresponding to the price paid for them. Glucose is the material commonly used for the basis of this product. In this way the price of the genuine articles has been depressed to a point which renders their profitable production problematic. To combat this condition an investigation has been instituted to study the methods in vogue for the manufacture of table sirups, to ascertain how the product can be improved, and to conduct experimental work in the growing and fertilizing of sugar cane to determine methods for securing the highest financial returns. An elaborate fertilizer experiment was conducted on the farm of Mr. W. B. Roddenbery, at Cairo, Ga., from which practical results of a valuable nature were obtained and reported in Bulletin No. 75, Bureau of Chemistry.

The manufacturing data, obtained largely at the factory of J. T. Wells, Guyton, Ga., will be published in a separate bulletin when the additional experimental factory work now going on at Waycross, Ga., is completed.

COLLABORATIVE WORK WITH EXECUTIVE DEPARTMENTS.

The collaboration authorized by Congress between the Bureau of Chemistry and such departments of the Government as may apply to the Secretary of Agriculture for chemical analyses has extended until it includes almost every branch of the service, the most extensive work having been conducted in connection with the Treasury Department. This collaboration included the sugar tests made on samples received daily from the appraisers' laboratories at New York, Boston, and Philadelphia, which comparative tests, extending as they have over a period of three years, have been productive of the most useful results in eliminating wide differences existing in the polarizations made at the ports named.

Other examinations made for the Treasury Department include an investigation of the percentage of ethyl alcohol in certain fusel oils imported into the country; an examination of the natural content of sugar in pineapples imported from different parts of the world; and the analysis of samples of ice and water intended for drinking purposes in the Bureau of Engraving and Printing.

Examples of cooperative work with other Departments are examinations of coal for the National Hospital for the Insane, at Washington, D. C., and paper for the Geological Survey, made at the request of the Secretary of the Interior; the examination of beverages offered for sale in Indian Territory, made on the request of the Attorney-General; samples of glue offered on competitive bids to the Government Printing Office; and a large amount of miscellaneous work for the Post-Office Department, including examinations of paper, ink, and stamps.

It is evident that work of this character, and especially such part of it as relates to the awarding of contracts, gains in uniformity and authority by emanating from one laboratory, and at the same time is more economically performed. The appreciation of this fact is seen in the constantly increasing number of requests received from other Departments for such work.

WORK OF THE LABORATORIES.

THE FOOD LABORATORY.

Upon this laboratory has devolved the greater part of the analytical work necessitated by the experiments with food preservatives, involving the examination of 5,500 samples, as well as all cooperative work on foods, such as pineapples, and the fermented beverage and fusel oil investigations. In addition, an exhaustive study of olive oil and its adulterations has been completed; a study of the composition of apples with special reference to changes in composition during ripening under different methods of cold storage has been continued in collaboration with the Pomologist of the Department; and 134 samples of fruit sirups and nonalcoholic beverages were secured in the open market and analyzed. The grape juices show a great improvement in the methods of preservation since the study made of them several years ago.

As heretofore, important work has been done in this laboratory in connection with the Association of Official Agricultural Chemists and the food chemists throughout the country in the investigation and comparison of methods for the analysis of foods. Two members of the staff have also done considerable work as associate referees on sugar for this association.

During the year a compilation of the pure-food laws of the various States was issued in five parts.

INSECTICIDE AND AGRICULTURAL WATER LABORATORY.

About 1,500 analyses were made in this laboratory, including the following lines of investigation: Mineral and irrigation waters; sanitary examinations of water; insecticides; the arsenic content of wall papers, furs, etc.; cattle foods; and toxicological examinations to determine whether bees are killed by poisons used in spraying. Most of these results, bearing directly as they do upon public health, either have been or will be reported in bulletin form. A portion of this work is performed in cooperation with the office of irrigation investigations and the Division of Entomology. Considerable work on methods of analysis for insecticides has been done by the chief of the laboratory as referee in the Association of Official Agricultural Chemists.

THE SUGAR LABORATORY.

In this laboratory the work on sugars for the Treasury Department was performed under the supervision of the Chief of Bureau. All analyses in connection with the cooperative experiments on sugar-producing plants (beets, sugar cane, and muskmelons) which have been conducted for several years in collaboration with various experiment stations are also made in the sugar laboratory. The total number of analyses reported was 1,744.

THE DAIRY LABORATORY.

Of the 1,056 analyses made in this laboratory, 807 were reported to the dairy division of the Bureau of Animal Industry, for which Bureau the chief of the laboratory served twice as a witness in a renovated butter case tried in New York State. The difficulty of distinguishing between butter produced by feeding cotton seed or cotton-seed meal and that to which foreign fats have been added, presented itself, and will receive special study during the coming year.

THE CONTRACTS LABORATORY.

The work performed in this laboratory included a large part of that referred to under collaborative work, and consisted mainly in the examination of samples submitted with bids for contracts to different branches of the Government, and in the development of qualitative and quantitative methods for the analysis of the same. Especially exhaustive examinations were made of khaki cloth for the Navy Department and 60 samples of ink for the Post-Office Department, a set of methods being determined in the progress of the latter work which were published as Circular 12, Bureau of Chemistry. Sample inks, prepared according to recipes developed in the laboratory, were sent to the Post-Office Department to be tested, and a set of standards established whereby to judge of an unknown ink.

THE ROAD-MATERIAL LABORATORY.

While the work of this laboratory has continued along the same general lines as in the past, its usefulness has been greatly extended, especially by the increase of its force.

The work of the chemist in charge included an investigation of the cause of the cementing power of rock dust, gravels, and clays, which involved many complete analyses and resulted satisfactorily. Other researches of immediate practical value have included a series of experiments on the burning and clinkering of clays, with a view to their use as road materials, and a study of the possibilities of increasing the binding power of materials by artificial means. During the coming year it is hoped that a thorough, practical test of burnt clays for country highways may be completed, as there are vast areas throughout our country where this is the only road material available, and the determination of the quality of clay adapted to this purpose would solve a great problem in road building.

Another important problem being studied in connection with such localities involves an elaborate series of experiments with mixtures of crude petroleum and asphaltum. The object of these experiments is to provide a binder surface for country roads which will place what would be practically an asphalt road within the reach of all rural districts, the cost of this mixture and its application being less than that of watering a macadam road.

Two new tests for determining the hardness and toughness of rock are to be adopted and reported on all routine samples, which it is believed will be of great assistance to road builders. These tests represent a new field of investigation and the machines for making them have been designed and are now in operation.

Other questions to receive special consideration are the testing of cement and concrete for road foundations, drains, and highway bridges, and tests on paving brick. The general testing of rock for macadam roads will be continued.

A bulletin on the testing of road materials, giving a detailed account of the methods employed and the results obtained in this laboratory, is now in press.

THE DRUG LABORATORY.

This laboratory went into operation on March 1, 1903, and has already reported on 120 samples of drugs and chemicals. The work so far done on representative samples of drugs shows that some of these articles are of a very unsatisfactory character. A bulletin entitled Adulterated Drugs and Chemicals is about to be issued.

BUREAU OF SOILS.

PROGRESS AND COST OF THE SOIL SURVEY.

The work in which the Bureau of Soils is engaged forms an important link in the chain of duties devolving on the Department. It is fundamental in character, and as the survey and classification of the soil progresses the results are being more and more made use of by other offices of the Department, as well as by outside investigators and by our citizens.

Up to this time the distribution of the surveys has been influenced by the desire to gain as wide a knowledge as possible of the soils used in the most important agricultural industries of the country, and in this way the work has been scattered through all parts of the country. Thus studies have been made of Eastern and Western fruit districts, of sugar-beet lands, of the cotton and rice lands of the South, of the corn lands of the Central West, and the wheat lands of the Northwest and the Pacific coast, and of the soils of all the important tobacco districts.

One important purpose of the work is to provide data for the comparative study of more or less widely separated areas devoted to the cultivation of similar products, with a view to carrying the better practices of one area to the other, and of suggesting improvements in the methods used and changes in the kind of crops grown. It is one purpose of the work to show where old industries can be extended or new ones established, while the value of the reports and maps to those wishing to purchase lands for any specific purpose is too evident to need emphasis.

The statistics collected by the Bureau will be particularly important in the carrying on of immigration and colonization enterprises.

The area surveyed and mapped during the fiscal year was 23,293 square miles, or 14,907,520 acres, an area just about equal to the total area previously surveyed since the beginning of the work, four years ago.

This enlarged work has been accomplished in part by the organization of five new field parties on the 1st of March, made possible by increased appropriations by Congress, and partly by keeping the parties continuously in the field, moving to Southern areas in the winter. While considerable time was lost in some of the areas by reason of excessive rains, upon the whole this plan has worked well and has materially reduced the cost per square mile. The work has been carried on during the year in 63 areas in 34 States and Territories, as shown in the following tables:

Areas surveyed and mapped during fiscal year ended June 30, 1903, and the areas previously reported.

State or Territory.	Work during 1903.	Work previously reported.	Total.	
	Sq. miles.	*Sq. miles.*	*Sq. miles.*	*Acres.*
Alabama	1,223		1,223	782,720
Arizona	108	503	611	391,040
Arkansas	251		251	160,640
California	1,959	1,962	3,921	2,509,440
Colorado	1,195	150	1,345	860,800
Connecticut	273	245	518	331,520
Florida	548		548	350,720
Georgia	186	571	757	484,480
Idaho	678	399	1,077	689,280
Illinois	2,241	1,356	3,592	2,298,880
Indiana	387		387	247,680
Iowa	576	440	1,016	650,240
Kansas		464	464	297,600
Kentucky	507	330	837	535,680
Louisiana	740	202	942	602,880
Maryland	487	2,147	2,634	1,685,760
Massachusetts	267	143	410	262,400
Michigan	30	828	858	549,120
Minnesota	233		233	149,120
Mississippi	661	656	1,317	842,880
Missouri	751	168	919	588,160
Montana		107	107	68,480
New Jersey	395	908	1,303	833,920
New Mexico		129	129	82,560
New York	1,075	483	1,558	997,120
North Carolina	1,221	3,425	4,646	2,973,440
North Dakota	856		856	547,840
Ohio	375	980	1,355	867,200
Oregon	386		386	247,040
Pennsylvania	266	938	1,204	770,560
Porto Rico		330	330	211,200
South Carolina	1,346	686	2,032	1,300,480
South Dakota	485		485	310,400
Tennessee		547	547	350,080
Texas	1,238	495	1,733	1,109,120
Utah	200	794	994	636,160
Virginia	1,143	1,604	2,747	1,758,080
Washington	51	459	510	326,400
Wisconsin	955		955	611,200
Total	23,293	22,445	45,738	29,272,320

Cost of survey.

Cost of field work	$51,136.60
Supplies	1,901.59
Traveling expenses between areas	5,215.76
Other expenses	5,059.56
Total cost of soil survey	63,313.51
Paid by State organizations	1,748.35
Paid by Department of Agriculture	61,565.16
Area surveyed ... square miles	23,299
Cost of work in field per square mile	$2.19
Transportation, supplies, and other expenses per square mile	$0.52
Total cost per square mile	$2.71
Cost to Department of Agriculture per square mile	$2.63

The cost of work in the field has increased from $1.83 per square mile, as reported last year, to $2.19 per square mile. This is due in part to increased salaries, necessitated by the fuller experience of the principal assistants, and in part to a large amount of rainy weather in the winter, which raised the cost in some of the Southern areas very considerably above the average.

On the other hand, the advantage of keeping the men out, in spite of the delays from the winter rains, is seen in the reduced cost per square mile where all expenses chargeable to the soil-survey work are included. Last year the average cost to the Department of Agriculture was $2.81 per square mile, and this year the total cost is $2.63 per square mile. It is probable that this is the lowest cost that can be reached, and from now on the cost may gradually increase somewhat, owing to the increased salaries which it may be necessary to pay to hold experienced men in the service.

There has been a great demand for our men from colleges and experiment stations and in private enterprises, but it has been the desire of the Department to keep the men at least five years in the soil survey, after which it is believed they will have had as much experience as they can get from such service, and they should then be prepared to take up special lines of investigation, or be ready to enter into positions of responsibility in educational institutions where soil investigations are being built up.

Although a total of $61,565.16 was spent by the Department for the soil-survey work and $1,748.35 by State organizations cooperating, and 63 areas were surveyed and mapped, with an average of 369 square miles each, we were unable to reach more than half of the areas in which surveys have been requested, and we have on file requests for nearly two years' work with the number of parties available with our present appropriations.

PUBLICATION OF THE REPORT ON FIELD OPERATIONS.

In my last report I called attention to the urgent need—if the full benefit of the soil-survey work is to be secured—of a change in the manner of publishing and distributing the reports on the soil surveys. As the law now stands, in the joint resolution approved February 23, 1901, the manuscript of these reports has to be submitted to the Public Printer all at one time, and the reports must be issued as one volume, with the maps in an accompanying portfolio. The Senate and House of Representatives together have 9,000 copies and the Department has 8,000 copies for distribution. This gives each Representative about 16 and each Senator about 32 copies—about enough for the public libraries and institutions in their respective States. In addition the Department has usually ordered from 500 to 1,000 reprints of the report on each separate area, and has distributed these as far as they would go in the districts to which the work pertains. Besides being entirely inadequate to fill Congressional needs, this manner of publication has the disadvantage of not enabling the Department to meet the local demands.

One of the chief values of this work lies in the suggestions it affords to the owners of land in the area in directing their attention to new crops and to better methods of agriculture. The bound copies that go to libraries, public institutions, and prominent citizens are very good as works of reference; but for the utmost good to come of the soil survey, copies of the separate reports and soil maps should be placed in the hands of a considerable number of people within the area surveyed, and our experience in the past has shown that there are from 500 to several thousand requests of this kind that the Department has not been able to meet. I would therefore recommend to Congress that, in addition to the bound volumes already authorized, there be printed in the form of advance sheets, as soon as the manuscript, maps, and illustrations can be prepared, a separate report on each area surveyed as completed, of which 500 copies shall be for the use of each Senator from the State, 2,000 copies for the use of the Representative for the Congressional district in which the survey lies, and 1,000 copies for the use of the Department of Agriculture. The reports could in this way be sent out from six to twelve months earlier than is now possible, and could be distributed while the matter is still fresh in the minds of the people who have watched the progress of the field work. It would also be practicable in this way to supply the local demand, a thing quite impossible under the present plan.

ALKALI RECLAMATION.

During the past year the Bureau of Soils has been engaged in making alkali reclamation demonstrations in several parts of the arid West. One such experiment is located near Salt Lake City, Utah, where there is an area of about 120 square miles (75,000 acres) of land unproductive because of excess of alkali. A tract of 40 acres, typical of this waste land, was secured in the summer of 1902 for the purpose of experiment, and the work of reclamation, which is being done in cooperation with the Utah Experiment Station and the owner of the land, has progressed rapidly and satisfactorily.

At the time of beginning the work on this tract it contained a little more than 2½ per cent of salt, or a total of 6,650 tons of salt in the soil to a depth of 4 feet. At the present time there has been removed from this tract, by the simple method of underdrainage and flooding, two-thirds of this quantity.

The following table gives the quantity of water added to the 40-acre tract and the amount of salt added in the irrigation water. The period covered extends from September 1, 1902, to September 1, 1903.

Total quantity of water used in flooding and amount of salt added from this source in the experiment at Salt Lake.

Date.	Water added.	Source of water.	Salt added.
1902.	*Cubic feet.*		*Pounds.*
September	284,400	Canal	24,000
October	940,000	do	83,900
November	171,300	Rain	
December	166,500	do	
1903.			
January	291,800	Rain	
February	136,400	do	
March	132,000	do	
April	112,000	do	
May	576,900	do	79,000
Do	760,900	Canal	
June	106,000	Rain	70,700
Do	676,500	Canal	169,190
July	36,588	Rain	
Do	1,691,966	Canal	
August	2,122,157	do	212,000
Total	8,305,411		638,790

The following table shows the drainage from the tract from September 1, 1902, to September 1, 1903, and the quantity of salt removed in the drainage water during that period:

Total quantity of water carried off through the drains and the quantity of salt removed in this way in the experiment at Salt Lake.

Date.	Drainage.	Salt removed.
1902.	*Cubic feet.*	*Pounds.*
September	158,700	152,200
October	265,000	195,100
November	251,000	353,800
December	139,700	187,600
1903.		
January	257,300	391,200
February	174,400	214,800
March	428,000	590,700
April	26,900	26,500
May	521,500	567,100
June	274,500	345,200
July	480,490	556,459
August	814,890	1,221,742
Total	3,792,380	4,802,601

From the foregoing tables it will be seen that there has been added to the Swan tract 8,305,411 cubic feet of water, equivalent to 57 inches in depth over the entire tract, and of this quantity 3,792,380 cubic feet, or 45 per cent, was recovered in the drainage. This drainage water, equivalent to 26.2 inches in depth over the entire tract, carried 2,401 tons of salt. Should we consider the seepage water which has drained into the subsoil and not out through the drainage tile, it is likely that at least 4,000 tons of salt have been eliminated from the land.

Seventy-five per cent of the area of the tract at Salt Lake contained less than 0.40 per cent of alkali in the first foot of soil as against 2½ per cent one year ago, and the entire area, it is believed, will be sufficiently sweetened by the end of the present season to permit the growing of a shallow-rooted crop. It will be seen from this that the ultimate complete reclamation of the land seems assured, and the Department believes that the object lesson thus afforded the farmers of this and other arid regions will stimulate them to take up the work of reclaiming these waste but fertile lands.

The value of the alkali lands at Salt Lake City is only $8 an acre, while lands not affected by alkali bring from $100 to $350 an acre. The cost of installing the drainage system was about $16 an acre, so that even with the additional cost of the irrigation water the margin of profit in the reclamation of these lands is wide enough to interest capital.

Besides the work at Salt Lake City, a tract of 20 acres near Fresno, Cal.—where lands have depreciated not less than $1,000,000 in value in the last few years on account of the rise of alkali—was taken under lease for reclamation. This land was at one time sold for $350 an acre, but had become badly alkaline, and was abandoned and of merely nominal value at the time of undertaking its reclamation. The work at Fresno has been quite as successful as at Salt Lake City, and at the end of four and a half months the greater part of the 20 acres was in condition to permit the planting of alfalfa, which crop will be seeded as soon as the proper season arrives.

The cost of installing the drains at Fresno was $15 an acre, but at Yakima, Wash., where a third experiment is under way, the cost was $21 an acre, a difference due mainly to the higher price for drain tile. The system at Yakima has also been successfully installed, and land, worthless for agricultural purposes at the inception of the experiment, will, it is believed, be in as productive a condition at the end of two years as contiguous lands now valued at $150 an acre.

It is the purpose of the Department to establish six of these demonstration experiments in parts of the West where there has been great loss from the rise of alkali. The need for such object lessons has been forcibly impressed upon the Department by the apathy of the communities where the alkali evil exists and increases. The people seem to stand in awe of alkali and to doubt that they can cope with it, notwithstanding the insistent teachings of experts to the contrary. This is not the case in Egypt, where vast areas of land more salty than any but the very worst soils in the Colorado Desert have been reclaimed by practically the same methods as those recommended by the Department and now successfully in use in these experiments. And these demonstrations have been undertaken in the belief that when the people see that the rise of alkali can be prevented, or that where alkali has accumulated it can be economically removed, they will take the matter into their own hands and either privately or cooperatively set about the systematic protection and reclamation of these very valuable western lands.

TOBACCO INVESTIGATIONS.

Some supervisory work was done in Connecticut during the past fiscal year, but the large purpose of the Department, which was to show the Connecticut tobacco growers that a wrapper leaf of superior quality could be produced on a specific soil type established in the soil survey of the Connecticut Valley, has been successfully brought to a close. It remains now for the growers to put the shade-grown Sumatra industry on a substantial basis, toward which condition great progress has already been made.

The investigation of the fermentation of Ohio tobacco has also been continued, and the interest in bulk fermentation, which is far better than the case method up to this time largely employed by the packers, is gaining ground.

The quantity of tobacco handled according to the method prescribed by the Bureau of Soils has increased from 655,200 pounds of the 1901 crop to 4,204,800 pounds of the crop of 1902. This tobacco is Zimmer Spanish and Little Dutch, varieties used in the manufacture of cigars, and the substitution of the bulk method of fermentation for the present practice of case fermentation will not only prevent great loss from rot and imperfect curing, but will also result in a general improvement in the several grades of this tobacco, and thus greatly increase the profits of the grower and packer.

By far the most important work of the Bureau of Soils during the past year, under the authorization for tobacco investigations, has been the experimental growing of Cuban cigar-leaf tobacco on certain soils in South Carolina, Alabama, and Texas. These soils, the Orangeburg sandy loam and the Orangeburg loam, are apparently very similar to the tobacco soils of Cuba, and the aroma of the leaf grown on one of these soils in Texas has been pronounced by the trade to be very fine. The crops grown on the experimental plots are now in course of fermentation, and it is too early to state definitely what the outcome will be, but so far as is now known the quality of the leaf will be excellent.

As these experiments in the South look toward the establishment of a new tobacco industry in that part of the country and to the production of a leaf to compete with the Cuban grown tobacco, a comparative statement of the production and value of the domestic leaf and the imports and value of the Cuban tobacco is appended.

Production and value of filler tobacco in 1901.

Type.	Production.	Value.
	Pounds.	
Ohio	35,654,314	$3,832,839
Pennsylvania	17,614,380	2,113,725
Other domestic filler	17,666,531	1,971,584
Total domestic filler	70,935,225	7,918,148
Imported Cuban, 1901	18,554,775	16,212,773

In the above table the production of the domestic tobacco is on the basis of the fermented leaf, 20 per cent having been deducted from the total production for shrinkage in fermentation and loss in handling. In the case of Ohio the necessary allowance for other types than the filler types grown in the State has been made. Two cents per pound has been added to the value of the domestic tobacco to provide for the expense of fermentation, etc., thus putting the Cuban imports and domestic filler on the same basis. It will be seen from these figures that the Cuban imports, while only one-fourth as great in quantity, represent two and one-third times the value of the domestic product.

It is the purpose of the Department, if the results of this year's work warrant, to carry on the filler experiments in the South on broader lines, similar to those of the Sumatra experiments in Connecticut, and then to extend its operations into other States where the results of the soil survey show that tobacco can be raised or where improvements can be made.

WORK OF THE SOIL LABORATORIES.

Besides routine work the laboratories of the Bureau of Soils have been developing several special investigations in the physics and chemistry of soils. Much of their work is of a purely technical character, necessary to a proper understanding and handling of the large soil problems which the Bureau is investigating, but not in itself of immediate interest or value to the practical agriculturist. Some of the work, however, has an immediate interest and is of a far-reaching and fundamental character.

The subject of most practical importance to the farmers of the country is the yield of crops, which has been popularly believed to be more or less directly influenced and controlled by the chemical characteristics of the soil. The Bureau has therefore made an exhaustive research, the results of which modify very materially the current conceptions of this matter. In considering the question the aim was to determine what amount and proportion of the several mineral plant foods were actually in solution in the soil at any one time, or from time to time; since it has been admitted by practically all authorities that it is the solution naturally existing in soils which is the immediate source of the mineral foods obtained by the crops growing upon them. Birner and Lucanus, as long ago as 1866, pointed out that plants can be grown to perfection in well water if suitable physical conditions are preserved, and, as a matter of fact, they grew oat plants in such water, renewed weekly, the yield of grain being double that from a rich garden soil.

Until the work was undertaken in this Department it had never been possible to make a satisfactory study of this subject, owing to the difficulties encountered in isolating the natural nutrient solution from the solid soil and in analyzing this solution for the extremely small amounts of dissolved material maintained in it.

By careful work and unusual ingenuity these analytical difficulties have been surmounted by the Bureau and methods devised that enable us to obtain the soil solution and to estimate, with a degree of accuracy little short of marvelous, the amounts of the constituents contained which are of significance for plant growth. Moreover, by means of portable outfits it has been possible to make these determinations in the field, where local conditions can be studied in conjunction with the analysis of fresh soil samples.

The chief of the Bureau, Professor Whitney, concludes, from the consideration of some hundreds of examinations with these new and exceedingly delicate methods, that there is no apparent relation between the dissolved salts of the soils, as determined by the methods, and the yield of crops, and that there are no constant differences between the different types of soil, although these types differ widely in their agricultural values. With such small differences as were actually found, quite as often the larger amount of plant food was found associated with a poorer crop, and vice versa; and, furthermore, the chemical differences between soils of various types with known wide variations in agricultural value, or between soils of the same type supporting on the one hand good, on the other poor crops, were no larger than those found between soils yielding approximately equal crops.

He argues, therefore, that nearly all soils are amply supplied with the necessary mineral plant food, and that these plant foods are not in themselves a matter of paramount importance to the agriculturist, for their supply as regards the plant is determined by the supply of soil moisture which the crop can obtain from the soil; that the chemical analysis of a soil can not in itself, therefore, throw much light upon the problem of fertility, but when the farmer attempts to control the factors governing crop yield his attention must be directed to the mechanical condition of the soil as affecting the supply of soil moisture with its dissolved mineral nutrient, to the effects of climate, to rotation, and to general soil management. These matters have all been fully treated in a recent publication (Bulletin No. 22) of the Bureau of Soils.

BUREAU OF STATISTICS.

WORK OF THE YEAR.

The work of the Bureau of Statistics has been continued on the usual lines. In addition to the regular work in estimating crop conditions, etc., statistical matter relating to the principal crops and farm animals, freight rates, exports, etc., in the United States and foreign countries has been prepared for publication, and numerous inquiries from various interested parties as well as Bureaus and Divisions of this Department have been answered, all of which has necessitated a vast amount of research and compilation.

Several special reports have been published during the year. These reports include a statistical description of the "Wheat Ports of the Pacific Coast," "Practices in Crop Rotation," "Flaxseed Production," "Commerce and Manufacture in the United States," "Milk Transportation: Freight Rates to the Largest Fifteen Cities in the United States," and "Relations of Population and Food Products in the United States."

FOREIGN AGRICULTURAL STATISTICS.

The statistical expert who has for some years had charge of the crop statistics of foreign countries competing with the United States has been stationed during the year in London, England, where he has been in closer touch with the statistical offices of the different European governments, whose reports, along with the most authoritative commercial intelligence of interest to American agriculturists, he transmits to Washington by mail or cable from time to time. Negotiations with the governments of various important grain-producing countries of Europe, and also with that of the Dominion of Canada, looking to a telegraphic interchange of crop reports similar to that already in operation between the United States and Hungary have been continued, and it is not improper to state that these negotiations have now reached such a stage that there are good grounds for believing that the growing season of another year will see the American farmer placed in as prompt possession of trustworthy statistics concerning the principal grain crops of foreign countries as he is of those of the United States.

COOPERATION WITH OTHER BUREAUS AND DIVISIONS.

During the year there has been cordial cooperation between the Bureau of Statistics and the Bureau of Plant Industry, the Bureau of Animal Industry, the Bureau of Forestry, and the Bureau of Soils, with such satisfactory results as to assure even greater cooperation and mutual dependence in the future than in the past. Throughout the whole of the research work of the Department the best results have been obtained by the cooperation of one set of specialists with another. The statistical work contained in the various publications of the different branches of the Department of Agriculture is largely done by employees of the Bureau of Statistics, and such statistical work as is not done in that Bureau is carefully revised by the Statistician and receives his approval before being published as the work of any other Division or Bureau of the Department.

COST OF CROP PRODUCTION.

In cooperation with the State Agricultural College of Minnesota, an investigation is being conducted by the Division of Statistics to determine the cost of production per acre of the principal crops. Although this work is not sufficiently complete to permit of publication of results at the present time, these data, when properly tabulated and analyzed, will undoubtedly be of great value in solving questions of farm management, and various other problems that confront the modern farmer.

THE STATISTICAL LIBRARY.

While there is no branch of statistics having a close relation to the agricultural industry that is not more or less adequately represented in the Department's statistical library, as regards the literature of prices, it is believed to be the best equipped library in the country, and no reasonable expenditure that may be necessary to maintain its present high standing should be withheld. Its card index to agricultural statistics is exceptionally complete and well arranged and has proved of great value to visitors who have had occasion to consult it.

BUREAU ORGANIZATION.

On July 1, 1903, the Division of Statistics became a bureau, and the Division of Foreign Markets was placed under the direction of the Statistician. Both the clerical and field forces will now be materially strengthened, and, while the work must necessarily be continued along practically the same lines as heretofore, no effort will be spared to strengthen and improve the reports on the staple crops and give more detailed information with regard to fruits and various minor crops. Until the present year it was found impossible to make quantitative estimates of any but the principal crops, but flax was added during the year, and the necessity for extending this work to embrace other products—such as rice, sugar, fruits, etc.—is every day being more forcibly brought to the attention of the Department. With a moderate addition to the field force the organization for collecting data will be sufficiently well organized to enable the Statistician to include details of all minor crops and of fruits in his monthly reports. But to successfully extend the work to embrace these crops it will be necessary to strengthen the office force by the appointment of a sufficient number of computers to collate and analyze the reports sent in by correspondents and field agents.

The organization of the field force has already been carried to a very high state of efficiency, and it is proposed materially to increase this efficiency by the appointment of additional field agents so soon as the bureau organization becomes effective.

It is my desire to so strengthen this Bureau as to enable it to become, as I conceive it should be, the principal source of reliable information on the agricultural resources of the country.

FOREIGN MARKETS.

COMPREHENSIVE INVESTIGATIONS.

Special comprehensive investigations involving much labor in the collection of statistics and in table building have engaged the efforts of the Division of Foreign Markets during the fiscal year. These investigations bring together vast amounts of information concerning the trade of this and other countries in exporting and importing farm and forest products which has not hitherto been in form readily available to the general public.

TARIFFS OF FOREIGN COUNTRIES.

On account of the numerous changes in the tariff laws of many important countries, frequent inquiries are referred to this Division for information regarding tariff rates and customs regulations of certain agricultural products in foreign countries.

In order to supply this information in condensed form, the Bureau has been charged with the publication of a series of bulletins giving, in English, the import duties on certain important groups of agricultural products that are levied in foreign countries.

The greatest care has been exercised to make this information accurate, and no efforts have been spared to get the most recent information from each country.

The countries, including their colonies and dependencies, for which these tariff schedules have been compiled, number 162, which includes, for the sake of completeness, the tariff of the United States and that of the Philippine Islands.

FIFTY YEARS OF EXPORTS.

The numerous demands for information as to export statistics of farm products from the United States, covering a period of years longer than the ten-year statements customarily made by this Division, have suggested the compilation of tables showing these exports for a long period of years, beginning with 1851. From these tables are derived the figures on our exports of farm products given in the earlier portion of the present report.

These figures exhibit a steady and regular increase in the volume of our agricultural export trade, in which cotton, grain and grain products, and meat and meat products were the principal factors. Other important items were live animals and tobacco. The five items mentioned have formed the bulk of our agricultural export shipments throughout the period 1851–1902, with the exception of the years 1861–1865 when, on account of the civil war, our exports of cotton were almost entirely suspended.

GERMAN IMPORTS OF FARM PRODUCTS.

The imports of farm products into the German Empire were made a special subject of inquiry by the Division of Foreign Markets, and resulted in a full analysis of products by kind and by country of origin.

Farm products constitute a much larger percentage of the imports of the German Empire than they do in this country, the percentage for Germany being 59.2 for the five years 1897–1901. The average annual value of the farm products imported from 1897 to 1901 was $745,198,480; the amount for 1901 was $790,564,700, of which amount the United States supplied 21.9 per cent. Of the imports of agricultural raw materials, the United States supplied 20.5 per cent; food products, 21.7 per cent; feed stuffs, 37.3 per cent; miscellaneous farm products, 3 per cent.

As contributors to the imports of farm products into Germany the various countries rank in order as follows, with the percentage of imports derived from each: United States, 21.9 per cent; Russia, excluding Finland, 16.3 per cent; Austria-Hungary, 10.6 per cent; British East Indies, 5.6 per cent; Argentina, 5.4 per cent; Italy, 4.4 per cent; France, 4.4 per cent; the Netherlands, 4 per cent; Brazil, 3.2 per cent; Belgium, 2.8 per cent; United Kingdom, 2.7 per cent; Dutch East Indies, 2.4 per cent; British Australasia, 2.4 per cent; Denmark, 1.6 per cent; Switzerland, 1.6 per cent; Roumania, 1.3 per cent. No other foreign country has a percentage as high as 1.

TRADE IN FOREST PRODUCTS.

This subject, which had hitherto received scant attention, has been made a prominent subject of investigation during the year just closed, and will hereafter receive the attention of this Division in conjunction with the subject of trade in farm products.

While it is true that in the immense aggregate of our foreign trade forest products occupy a small place relatively, yet, expressed in value, this trade has grown to large proportions, the growth being more especially manifest in exports than in imports. The domestic exports of forest products in 1893 amounted to $28,127,281, and during the five years 1893–1897 the annual average was $31,782,928. During the following five years, 1898–1902, the annual average grew to $47,648,530, the highest amount for one year being $55,369,161 for 1901. This average was considerably exceeded in 1903, when the amount was $58,281,124. During the eleven years the value of the domestic exports of forest products was about 3 to 4 per cent of the total domestic exports.

During the five years 1893–1897 the annual average value of the imports of forest products was $44,638,795, an amount from which the imports for each year did not vary much. In the following five years the annual average increased about $10,000,000, making the average for 1898–1902 $55,205,996; the highest amount for one year was $60,633,078, in 1900. In 1903 the value of the imports of forest products rose to the highest figure yet attained, $71,478,022. The relation between the value of the imports of forest products and the total imports is expressed by 5.9 per cent for the five years 1893–97, being 7.1 per cent for the five years 1898–1902 and 7 per cent for the year 1903.

The imports of forest products are constituted chiefly of various gums, india rubber, cork, dyewoods and their extracts, and cabinet woods; also timber, lumber, and wood pulp, principally from Canada. It appears, then, that the principal portion of these imports is of materials that do not grow in this country or, if growing here, are not produced in sufficient quantities for the demands of consumption, as in the case of timber, lumber, and wood pulp.

The imports of agricultural products for 1903 amounted to $456,199,325, a higher amount than for any preceding year and $36,060,037 greater than for 1900. Of the total imports, 44.5 per cent are classified as belonging to farm products. This percentage shows a decline; for the five years 1893–1897 it was 51.5 per cent and for the five years 1898–1902 it was 48.7 per cent.

Farm products have declined as an element of domestic exports also during the last eleven years, although no decline is perceptible during the last five years. In 1903, 63.1 per cent of the total domestic exports was composed of farm products.

Upon combining the domestic exports of forest products with those of farm products, the total constitutes 67.3 per cent of all domestic exports for 1903. The percentage for the preceding five years was 68.8. The value of the farm and forest products exported for 1903 was $936,760,575, compared with which is the annual average of the preceding five years, $908,686,344, and the average of the five years 1893–1897, $647,857,875.

These two classes of products constituted 51.4 per cent of the imports of 1903, the percentage for the preceding five years being 55.8 and for the five years 1893–1897, 57.1. In value the imports of these two classes of products in 1903 amounted to $527,677,347, in comparison with which are the annual average of the five preceding years, $434,331,088 and the annual average of the five years 1893–1897, $33,805,721.

DIVISION OF ENTOMOLOGY.

WORK ON INSECTS FROM ABROAD.

THE ASIATIC LADYBIRD ENEMY OF THE SAN JOSE SCALE.

In the report of last year a rather full statement was made concerning the importation of a ladybird enemy of the San Jose scale, found in China and Japan by the first assistant entomologist. During the late summer of 1902 eight colonies of this beetle were distributed in six States. In the experimental orchard of the Division of Entomology the insect wintered well out of doors, and started breeding early the present season. The colonies distributed during that summer were mainly put in charge of entomologists of State experiment stations. During the early summer of 1903 some 26 colonies were distributed in Maryland, North Carolina, Georgia, Alabama, Delaware, New Jersey, New York, Ohio, Oregon, Tennessee, Virginia, and West Virginia.

Of last year's distributions, those sent to Georgia have given the best promise. One of these established in a large orchard of 17,000 peach trees, with a contiguous orchard containing 250,000 trees, both orchards infested with scale, shows the most satisfactory results. By the 1st of July, 1903, the ladybird had spread through the original orchard of 17,000 trees and then occurred to the number of thirty or forty thousand. Three additional broods are expected during the season, and these numbers should be vastly augmented. Colonies have been distributed from this orchard to various parts of Georgia.

The experiences of the year have, therefore, been very encouraging. Every effort will be made to distribute this beetle throughout the regions where the San Jose scale occurs. The work, however, is still in the experimental stage, and too great hopes should not be aroused. Recommendations for the prompt application of sprays and other remedial treatment should not be neglected.

OTHER BENEFICIAL INSECTS.

The fig fertilizing insect continues to be a great success in California. Large crops of figs were raised at Fresno, and the quality seems to have been even better than during the previous year. A number of new orchards of Smyrna and capri-figs have been started, and there is no doubt that the insect has been thoroughly acclimatized at Fresno and at Niles.

One of the most striking of the recent beneficial results of these introductions has been the good work done by the parasitic enemy of the black scale (*Scutellista cyanea*) which was originally imported by the Division of Entomology from Italy and later from South Africa, and established in the orange and olive groves of California. The best work has been done in the southern part of the State, where the insect has been established in every county south of Point Conception. It is very plentiful in Los Angeles, Orange, and San Diego counties, and is still being sent out from the office of the First Deputy Commissioner of Horticulture at San Francisco. The Los Angeles commissioners distributed over 400 strong colonies at Escondido. At Pasadena the insects have spread naturally, and in the colonization districts over 90 per cent of the black scale has been destroyed by the parasite, which is still breeding.

WORK ON THE COTTON BOLL-WEEVIL.

The continued spread of the cotton boll-weevil, and the danger threatening the most important industry of the South by the direct prospect that it will soon reach all portions of the cotton belt, resulted in the appropriation by Congress of $20,000 for a continuation and enlargement of the work of the Division with that pest. This work was under the direct charge in Texas of Mr. W. D. Hunter, who was aided by a number of assistants.

The funds at the disposal of the Division enabled it for the first time to conduct experiments with the cultural methods of controlling the pest on a large scale. This was accomplished by entering into contract with two representative large planters in typical situations in Texas. By the terms of these contracts the planters agreed to plant, cultivate, care for, and in every way manage the crop exactly in accordance with the directions of the agent in charge. In this manner the Division was given practically complete charge of 325 acres, but without the trouble and expense of renting the land and working the crop. These experiments were located at Calvert, in the Brazos Valley, the most seriously infested portion of the territory at present, and at Victoria, in the extreme southern portion of the State, where the existence of volunteer cotton furnishes the weevils with food very early in the season, thus adding an important feature to the problem that does not occur elsewhere.

At Victoria a field laboratory was fitted up, where a thorough study was made of every feature of the life history of the weevil. The matter of parasites and the possibility of controlling the pest by their artificial propagation, which has always appealed strongly to many planters, received especial attention. In pursuance of this feature of the investigation the agent in charge made a trip to Mexico, where the governmental commission that had been created for the study of the weevil problem has especially concerned itself with the propagation of a mite (*Pediculoides ventricosus*), which, at least under certain conditions, has been found to destroy the larvæ of the pest. The agent made a study of the methods pursued in the laboratory of the commission at Cuernavaca, and through the courtesy of Prof. A. L. Herrera, the head of the commission, he was enabled to bring back to Texas a large number of cultures. These parasites were distributed from the laboratory at Victoria. The work is being continued this season, but the indications are that climatic conditions will always render unobtainable in Texas whatever useful results may have been obtained in Mexico.

WORK ON INSECTS DAMAGING FORESTS.

With the beginning of the fiscal year a section of the Division of Entomology was organized for the investigation of insects injurious to forests. Dr. A. D. Hopkins was put in charge of this work, and during the year three assistants were assigned to him. The work was carried on in cooperation with the Bureau of Forestry, and investigations have been made in nearly all of the States and Territories. Depredations by a bark beetle on the Silver Pine, Red Fir, and Lodgepole Pine in the Priest River Forest Reserve in Idaho, and by an important wood-boring enemy of the Red Fir near the Olympic Forest Reserve in Washington, were investigated.

An important result of the work of the year was the determination that the destruction of many large areas of timber, which was supposed to be the result of forest fires, was primarily the work of insects, the insects having killed the timber, which then offered favorable conditions for the starting of extensive fires. A serious trouble affecting the pines in the Rocky Mountain region from Arizona to Idaho, caused by bark beetles and which resulted in the death of a vast amount of timber in the national reserves and on public and private lands, was also investigated.

Many other similar investigations were carried on, and the most encouraging progress was made in the attainment of the principal object of the work, namely, the discovery and practical application of methods of preventing losses from the ravages of forest insects. The recommendations for checking the rapid spread of pine-destroying beetles in the Black Hills were adopted by the General Land Office of the Department of the Interior with good results, as were also recommendations for the control of the serious insect trouble affecting the pine timber on some 200,000 acres of forest and ranch land in northeastern New Mexico.

Three field stations were established, one in the Black Hills, one at Tryon, N. C., and one at Hoquiam, Wash.

WORK ON THE CODLING MOTH IN THE NORTHWEST.

This work, which has been referred to in previous reports, was completed during the autumn of 1902. The special agent in charge during the following winter completed a full report on the investigation, which indicates very satisfactory results. Demonstration on a large scale of the efficacy of the measures adopted and recommended showed to the satisfaction of all concerned that the economical control of the codling moth in the Northwest is possible. It was conclusively shown that in the infested regions of the far Northwest from 85 to 100 per cent of the fruit was injured if no remedial measure was used, but that on intelligent application of the remedies advised by the Division of Entomology from 85 to 98 per cent of the fruit might be saved.

OTHER INVESTIGATIONS.

The work upon injurious scale insects has been carried on through the year. The methods of controlling the San Jose scale have become more effective, and the advice issued by the Division of Entomology is embodied in two recently published and revised circulars giving the latest methods of control. Much work was done in the determination of scale insects for experiment stations and individuals, including the study of considerable material received from foreign sources, and especially from our new possessions, Porto Rico and Hawaii.

The investigations of insects injurious to truck crops have been carried on, and a special study has been made of those forms which injure the sugar beet.

The work on insects injurious to stored products has also been measurably successful, and the remedies proposed for this class of insects have been successfully tried by many individuals. An especial study has been made of the injuries of the so-called powder-post beetles to the wood used in making agricultural tools and furniture.

The insects affecting ornamental plants have also been studied to advantage.

The investigations of insects in their direct relations to the health of man, which have been under way for two years past, have been continued. Careful studies have been made of the habits and geographical distribution of the mosquitoes which convey malaria and those which convey yellow fever. An extensive investigation of the insects attacking the stems of growing wheat, rye, barley, and oats, not, however, including the Hessian fly which was earlier dealt with, has been completed during the year, and a final report prepared for publication.

The insects which affect mushrooms, the gadflies or horseflies, the insects which affect the seed of the clover plant, and the insects which affect the cranberry have been studied during the year and are being written up.

The work on insects affecting shade trees, which has been carried on now for several years, has been continued, and the preparation of an extensive bulletin on this subject is under way.

WORK IN SILK CULTURE.

An appropriation of $10,000 to the Department of Agriculture for investigations in silk culture was made by Congress for the fiscal year 1903. The conduct of this investigation was placed in the hands of the Entomologist. Previous work by the Department in the years 1882 to 1891 had already demonstrated the possibility of raising excellent cocoons of the domestic silkworm in all parts of the United States in which the White Mulberry tree will grow. Therefore, in the investigations to be undertaken at this time, the whole attention of those in charge is naturally devoted to the main practical aspects of establishing the industry. Undoubtedly the first steps are to create a general interest in the subject, to insure the supply of leaves for food for the worms, and to educate as many persons as possible in the care of the worms, so that a crop of cocoons will be assured to any individual or company desiring to go into the reeling business. The Entomologist, during the summer of 1902, visited the silk-growing regions of Europe and investigated the establishments for the selection of pure eggs and also investigated the communities in which silk culture has its strongest hold. He also contracted for the purchase of two four-basin reels. Considerable quantities of silkworm eggs of the best races were purchased, and mulberry seeds and cuttings of the best varieties were also contracted for.

During the winter and early spring eggs were sent in small quantities to all applicants who were able to assure the Department that they had at hand a proper supply of food for the worms. To those who had no food mulberry cuttings were sent. A small crop of cocoons was raised at the Department in the spring of 1903. Nearly all of the persons to whom eggs were sent reported that they had been able to rear the worms and produce the cocoons without great difficulty, and letters were sent informing the raisers that their cocoons would be purchased by the Department at the current European market rates. One of the reels imported from Europe was put in operation at the Department of Agriculture, in Washington. Two expert reelers were secured from France, and at the close of the fiscal year reeling operations were about to begin. The second of the four-basin reels was loaned to The Seri-Culture and Manufacturing Company, at Tallulah Falls, Ga., where extensive planting of mulberry trees has been carried out and where experimental work is promised.

The establishment of the silk industry in the United States must be a matter of extremely slow accomplishment. Small appropriations by the General Government will assist in the education of an increasing class of silk raisers. The lack of a market for cocoons is the great difficulty at the present time. The limited market created by the

Department out of this small appropriation is in reality an artificial one. It is necessary, however, to induce people to continue their interest in the subject and to educate a class of silk raisers, and for the present this method will be continued.

APICULTURAL INVESTIGATIONS.

The correspondence in relation to apicultural matters has been constantly increasing, and has covered a wider range of subjects.

In the autumn of 1902 a trip was made by the apicultural investigator through Nebraska and Colorado for the purpose of investigating certain conditions, especially in Colorado, regarding natural and artificial bee pasturage and the early breeding up of colonies of bees to enable bee keepers to take full advantage of the first crop of alfalfa. The recommendations made to cultivate early pollen-bearing crops, such as Russian hairy vetch, and to employ more prolific, hardy, and strong-winged bees than Italians, such as the Carniolan and Cyprian races and their crosses, have, wherever followed, resulted in a marked increase in the honey yield and in earliness and size of swarms.

A number of queens of select breeding have been sent this year, as in the past, to experiment stations engaged in apiarian investigations, and for testing in sections where it seemed advisable to try certain breeds or crosses.

A race of bees little known in this country, the Caucasian, native to the southeastern provinces of Russia, bordering on the Black and Caspian seas, has been under observation. It promises to be a valuable addition to the varieties already bred in this country. The workers are good honey gatherers and most remarkably gentle. The queens are quite prolific. The exact status of the race as regards hardiness has not yet been determined, although in Colorado they have not seemed inferior in wintering qualities to the Italians already there.

EXPERIMENTAL WORK WITH INSECTICIDES.

The value of the standard insecticides, both for biting and sucking insects, including food poisons and substances which kill by contact merely, has been established by many years of experiment, but nevertheless, by the practical work of the Division of Entomology, such standard insecticides receive each year the indorsement of additional satisfactory experience. This applies not only to the control of insect enemies of field and garden crops and fruits, but also to house pests, as illustrated by additional practical work done during the year with the hydrocyanic acid gas treatment of houses described in the last annual report. The experimentation with petroleum oils, referred to in the former report, has been started during the present year in conjunction with the Bureaus of Plant Industry and Chemistry of this Department. This work, it will be recalled, was undertaken in response to special requests from the Society for the Promotion of Agricultural Science and from the Association of Economic Entomologists.

BIOLOGICAL SURVEY.

The Biological Survey is engaged in three distinct lines of investigation, each of which is as important and independent as the usual work assigned to a division of the Department. These lines consist of (1) the mapping of the boundaries of natural life and crop zones of the country, from which may be determined the agricultural products suitable to the different climatic conditions that prevail in different parts of the country, and so likely to be a commercial success; (2) investigation of the economic relations of birds to agriculture and horticulture, in order to determine what birds are useful and what injurious to these interests and to what extent; and (3) the preservation and introduction of game, and also the supervision of the importation of foreign birds, to prevent the introduction of undesirable species, such as have caused much damage in other countries or are likely to become pests in this country.

DETERMINATION OF LIFE AND CROP ZONES.

In determining the feasibility of profitably raising a certain kind of crop for market the first question presenting itself is, Is the climate suitable? This question is largely determined by biological surveys or the investigation of the geographic distribution of plant and animal life. Lines are run through a State wherever necessary, and the plant and animal life and effects of physiographic and climatic conditions are carefully noted. From these lines maps can be made, showing the location throughout the State of life zones—in other words, belts that are adapted climatically to certain crops.

During the year the survey of Texas has advanced to such a point that a little additional work will permit the mapping of the life and crop zones and the publication of a full report of the biological character of the State. This survey should obviate many expensive agricultural experiments.

California presents peculiar difficulties to this work owing to the great diversity of climate found throughout the State, ranging from the Alpine summits of mountains, with their perpetual snow, to torrid deserts, hotter and drier than those of Africa, and including regions where frequent fogs and heavy rains prevail. The enormous agricultural interests of California, with its shipments of more than $60,000,000 worth of vegetable products annually, add materially to the value of the final result. As soon as available funds and the difficult character of the country will permit, a biological map of the State will be published, which, it is believed, will be of inestimable service to agriculturists and horticulturists of the State.

It is very desirable to secure as much information as possible concerning Alaska, in view of the tide of immigration setting in toward that Territory and its consequent development. Work was carried on at several points in the Territory, choice being made of such as would yield the broadest possible results with the limited means available for the purpose. The base of the Alaska Peninsula, on both coasts, and several of the lakes and rivers of the interior, notably Lakes Iliamna, Clark, and Becharof, and the Chulitna, Nushagak, and Ugaguk rivers, were the field of exploration. This region is one of unusual importance for biological investigations, as it includes the northwestern limit of the Pacific coniferous forest and is the point of junction of several life areas.

ECONOMIC RELATIONS OF BIRDS TO AGRICULTURE.

The study of the relations of birds to agricultural interests was continued under the two lines that have heretofore occupied attention, namely, laboratory work and field investigation. In the laboratory attention was mainly directed during the past year to the stomachs of game birds, in preparation for issuing a report upon their food habits, in order to meet a constantly growing demand upon the subject.

Field work included a continuation of investigations on a certain Maryland farm, which formed the subject of one of the bulletins of the Division issued during the year, and the study of the food habits of birds in the principal fruit-growing districts of California, begun in 1901. The California work, as noted in previous reports, has yielded important results, which will be very useful to horticulturists by making it apparent which birds are serviceable and which are injurious to their interests.

Complaints have been received by bee keepers in California of great harm to their business, caused by certain birds, which, it is alleged, destroy large numbers of worker bees. Partial investigations of this complaint do not sustain these charges, but further study is necessary before a final report can be made.

In many parts of the country serious loss is entailed on agriculturists by periodic invasions of noxious insects. When such outbreaks occur hereafter they will be investigated, if practicable, by this Division in conjunction with the Division of Entomology, in order to ascertain, as far as possible, what influence is exerted by birds in checking the increase of the pests and thus diminishing the extent of their ravages.

GAME PROTECTION AND INTRODUCTION.

ENTRY OF FOREIGN BIRDS AND ANIMALS.

The duties assigned to this Division relating to game protection are based on three acts of Congress—the Lacey Act of 1900, the egg act of 1903, and the Alaska game law of 1902. The permits required by the Lacey Act for the entry of foreign birds and animals numbered 387 during the year, and allowed the entry of 629 mammals and 53,106 birds. Under the egg act 2,000 eggs of game birds were imported. Importations of cage birds are made mainly at New York and San Francisco, though parrots are frequently entered at New Orleans and different ports of entry along the Mexican border. Pheasants of various kinds for propagation are imported from Canada in considerable number, coming chiefly through the ports of Detroit, Buffalo, and Niagara Falls. The animals that are brought into the country are almost entirely confined to such as are designed for exhibition purposes in circuses and zoological parks. Most of the importations of cage birds are made by regular dealers, and are subject to the usual inspection. In the case of passengers bringing in a few birds as pets, it has been found desirable to obviate the annoyance sometimes caused by the delay needed to secure permits, and the facilities granted at New York have been extended to San Francisco. Under the arrangement thus made not more than five birds may be declared by passengers with their personal baggage before an officer of the customs and landed without formal permit. A strict account of the birds thus entered is kept by the customs authorities and reported quarterly.

The object of the law is to eliminate the danger of the introduction of birds or animals which might become serious pests. That such danger is constantly present is shown in the history of Australia, Porto Rico, Hawaii, and other countries, and is instanced by the introduction and spread in the United States of the European sparrow, and to a much more limited degree of the Old World starling. Although the entries at San Francisco are few as compared with those at New York, the danger of introducing injurious species at that port is probably greater than at any other. With a view to still further improving the service at San Francisco, a careful examination was made there in June of the peculiar conditions attending importations from Australia and the Orient, which, it is believed, will be productive of much good. It is hoped that all danger of the introduction of such species as may prove to be pests can be eliminated. So far as is known, the law has thus far been effective. Two mongooses from Jamaica were killed at Philadelphia; 1 mongoose from the Philippines and 2 flying foxes from Australia were destroyed at San Francisco; and 50 flying foxes that arrived at New York from Singapore in December were reshipped to Hamburg, Germany.

ENFORCEMENT OF GAME LAWS.

The cordial cooperation of the Attorney-General and State officials has enabled prompter disposition of cases arising from the illegal shipment of birds and game than ever before. Thirty-five such cases, involving the shipment of 3,729 birds, were reported to the Department, a decrease of four cases and about 1,300 birds from those reported during the preceding year. Since the passage of the act 40 convictions have been secured in cases passing through this Department, and about 20 cases are still pending. Efforts have been concentrated upon one or two areas in the West, where illegal shipments seem to be especially frequent, in order to secure more satisfactory results with the limited means available. Illegal shipment of game has been very frequent in the past, and various methods have been adopted to conceal the character of the shipment. The violators of the law have, however, been driven by increasing insecurity in their illegal trade to new devices. Thus, a consignment recently seized in the Northwest disclosed game birds concealed in bales of hay which had been forwarded by slow freight. In the attempt to curtail these illegal shipments, I have been much aided by the cooperation, cheerfully and cordially given, of express and railroad companies, and there is reason to believe that illicit shipments can, at comparatively small cost, be reduced to a minimum and the great inroads they make upon the game of our country checked.

PROTECTION OF GAME IN ALASKA.

In Alaska, in the absence of a specific appropriation permitting the employment of competent wardens, it has been impossible to secure a reasonable observance of the game law. Much care has been exercised, however, in the case of the export of heads and skins, and the shipment of these from Alaska for purposes of sale in the United States in violation of the law has been practically stopped. Misinterpretation of the statute was the means of temporarily curtailing the trade in black bear skins, but the misconception has been corrected as far as possible.

PUBLICATIONS.

Under the provision of the Lacey Act requiring the collection and publication of useful information relating to the propagation, uses, and preservation of birds, posters and bulletins have been published annually, showing the close seasons and other provisions of the game laws of the United States and Canada, also lists of game officials in the various States, and other information of like character. The digest of game laws was issued as a Farmers' Bulletin in order to meet the demand and to place a sufficiently large number at the disposal of members of Congress. The compilation of laws relating to nongame birds has been of considerable service. Much of the rapid progress in the character of the legislation protecting birds is directly traceable to the dissemination of the information it contains, and it is noteworthy that the adoption of our system of bird protection has recently been strongly advocated in Brazil and Mexico.

RECOMMENDATIONS.

It has been found impracticable to transport, fence, and maintain elk and other animals on forest reserves and other public lands with the appropriation of $1,000 made for that purpose. I have recommended, therefore, an increase of the appropriation to $5,000 for the ensuing year.

The three distinct lines of work assigned to this Division could be conducted much more economically and effectively were the Division reorganized as a bureau of three divisions, each to have charge of one of these lines, and were a larger amount appropriated for the performance of the work. I have accordingly recommended such reorganization, with an increase of $1,450 in the statutory roll and $12,000 in the lump fund, in order to accomplish this change and meet the greatly increased demands of some of the sections of the Division.

OFFICE OF EXPERIMENT STATIONS.

PROGRESS OF THE EXPERIMENT STATIONS.

The success of the agricultural experiment stations in leading the way to the improvement of agricultural practice on a grand scale is having as one of its effects a closer union between the stations and the farmers in enterprises directly affecting farm methods. This is leading to demands that the stations shall conduct at least a portion of their investigations in a larger and broader way, in order that the results of scientific investigations, whether in the field or the laboratory, may be more definitely and thoroughly applied in practice under the conditions actually encountered on the farm. A good example of this may be found in the recent cooperative experiments conducted by the Iowa Station at Odebolt, Iowa. The proprietor of a large farm at that place desired to know whether or not the by-products of corn, flaxseed, or cotton seed, or some of the prepared stock feeds when fed in conjunction with corn, would give better results than corn alone. He furnished 220 cattle and the corn roughage necessary for conducting a feeding experiment. The Iowa Station furnished the by-products and stock feeds and conducted the experiment. The first test gave results indicating that the addition of so-called condimental stock feeds to a corn and wheat-straw ration gave much lower returns per steer than corn and wheat straw alone.

One of the results of the thorough work of the Illinois station on the breeding of corn has been the formation of the Illinois Seed Corn Breeders' Association. The success of this enterprise has been phenomenal. All of the available supply of the improved seed is rapidly disposed of to farmers and much of it is engaged in advance. The work of this station on corn is proving to be far reaching in its results, not only in improving the general quality of seed corn, but in inducing practical men to undertake the breeding for special qualities—for protein, for oil or for starch—which the station has demonstrated to be entirely feasible. As a recognition of the value of such work, the farmers' organizations of Illinois have rallied to the support of that station, securing last year State appropriations aggregating $46,000 for special investigations and this year nearly twice that amount, or $85,000.

The Minnesota station has been extending its investigations in the breeding of improved varieties of wheat and other kinds of grain, making thousands of crosses, and, wherever promising new varieties are found, testing them in a large way, both at the station and on hundreds of farms throughout the State.

The amount of data published by the stations on many agricultural subjects is now very large, and the recent attempts which have been made to reduce this material to organized form in order that it may be utilized for purposes of agricultural education have shown that the stations are doing a great work in supplying the materials out of which a definite science of agriculture is being constructed, and on which courses of instruction in agriculture of different grades can be successfully based.

If our stations are to be continued on the broad basis on which they are at present organized they must generally be supplied with larger funds for the general expenses of investigations in order to conduct their work in a thorough and satisfactory manner. The States can and undoubtedly will supplement the National funds more fully as time goes on, but since the results obtained by the stations are in many cases of general value to the agriculture of the United States, it is worthy of consideration whether they should receive additional financial aid from the National Government. This supplemental aid should, if given, be granted under conditions which will insure its exclusive application to meet the expenses of agricultural investigations.

THE AGRICULTURAL COLLEGES.

Special appropriations for the better equipment and maintenance of the agricultural colleges, aggregating more than $1,250,000, have been made by the States during the past year. The movement in the direction of basing the courses of instruction in these institutions more largely on the science and practice of agriculture itself is continuing, and already has resulted in a considerable increase in the number of students pursuing agricultural courses. A special effort is now being made in a number of our strongest agricultural colleges to make their courses more complete by adding systematic instruction in farm mechanics and rural economics. Increasing attention is being given by these colleges to the holding of summer schools, one purpose of which is to prepare teachers for giving instruction in nature study and elementary agriculture in the common schools. The interest in work of this kind is especially strong in the South at this time, as is shown by the large enrollment of teachers in the Southern institutions. The attendance at the land-grant colleges for the year 1902 aggregated 46,699 students, of whom 6,299 were in agricultural courses. The graduates of these institutions in 1902 were 4,443, and since their organization, 50,026.

This Department is cooperating with the Association of American Agricultural Colleges and Experiment Stations in the preparation of a comprehensive exhibit at the Louisiana Purchase Exposition showing the progress of agricultural education and research in this country.

SECONDARY AND ELEMENTARY SCHOOLS OF AGRICULTURE.

The attendance at the two county agricultural high schools opened in Wisconsin in the fall of 1902 was large, and the interest manifested in these schools was so great that the State legislature at its last session, recognizing the demand for instruction of this grade, made provision for additional county agricultural high schools with State aid. At the California Polytechnic Institute, San Luis Obispo, buildings have been erected and everything put in readiness for opening the school with agricultural courses this fall. The Mount Harmon School, near Northfield, Mass., founded by the late D. L. Moody, has decided to establish an agricultural department and to offer courses of instruction in that subject. The school already has an equipment consisting of a farm of about 1,000 acres, a dairy of about 200 cows, fruit orchards, and a cannery for putting up vegetables. Mr. Harry Hayward, a graduate of the school and for several months past assistant chief of the dairy division of this Department, has been called to the school as director of the agricultural department. This step on the part of one of the largest secondary schools of the United States is a matter of great interest to those who are following the progress of secondary instruction in agriculture, and is especially significant from the fact that the institution is not a technical school and this is the first attempt to establish an industrial course.

The committee on methods of teaching agriculture of the Association of American Agricultural Colleges and Experiment Stations made a report to the convention of this association held at Atlanta, Ga., in October, 1902, in which it showed that courses in agriculture could be introduced into the public high schools without any violent or radical reorganization of existing programmes for such schools.

Many of the officials in charge of our public high schools and elementary schools are also considering the advisability of introducing agricultural subjects into the curricula of these schools, more especially by giving an agricultural trend to nature-study work.

School gardens, meaning by the term flower and vegetable gardens utilized for educational purposes, are found in the East, the Middle West, the South, the far West, and our insular possessions. They are maintained in connection with the kindergarten and with every other grade up to the high school.

This Department has been aiding the school-garden movement in several ways. Through the Bureau of Plant Industry it has distributed special packages of vegetable and flower seeds to a large number of schools, and conducted a number of school-gardening experiments in cooperation with the schools and charitable organizations of Washington, D. C. Officers of the Department have in several instances volunteered to direct these experiments outside of office hours. One of the most successful of these experiments was conducted on the Department grounds with a class of 30 boys and girls from a near-by school, under the direction of the science teacher in the normal school of the city.

THE FARMERS' INSTITUTES.

In consequence of the action of Congress during the session of 1902–1903, making definite provision for the work of the Office of Experiment Stations relating to farmers' institutes, it has been possible to put this work on a permanent basis and to begin the formulation of a policy regarding its development.

As a result of a civil service examination, Prof. John Hamilton, of Pennsylvania, was appointed farmers' institute specialist. He has been for many years a lecturer and manager of farmers' institutes, and is thoroughly acquainted with their past development and their present needs.

Since the work of this Department relating to farmers' institutes is based on the principle of giving aid to the institutions maintained under the authority of the States, this Department has established the rule of working in this line through the State officers charged with the management of the institutes.

It is difficult to realize the extent and importance of the farmers' institute movement and its vital relation to the successful incorporation of the results of scientific investigations in our agricultural practice. Under present conditions, with the rapid changes in the personnel of our agricultural population and the almost entire absence of agricultural instruction in our elementary schools, it is of the greatest importance that our adult farmers shall receive definite information regarding improved methods of agriculture and the principles which lie at the foundation of progress in agricultural practice.

EXPERIMENT STATIONS IN ALASKA.

During the fiscal year ended June 30, 1903, experiment stations were maintained at Sitka, Kenai, and Rampart, and a new station established at Copper Center, the experimental work for the most part including the growing of cereals and vegetables, methods of reclaiming, draining, and fertilizing land, and the curing and ensiling of crops. The distribution of seed of hardy varieties of vegetables, cereals, and grasses has been continued and extended, and beneficial results have accrued, as is shown by the constantly increasing number of gardens and other plats of ground which are brought under cultivation. The supervision of voluntary observers of the Weather Bureau in Alaska has been continued as in former years, there now being 20 meteorological stations which report to the experiment station at Sitka.

The new station which has been opened at Copper Center consists of a tract of about 775 acres, situated in the Copper River Valley, a little more than 100 miles from the seacoast. This tract of land has been withdrawn from entry by the Secretary of the Interior and set aside for the use of the station.

At the Kenai Station about 15 acres have been brought under cultivation and all the hardy vegetables, buckwheat, oats, barley, and other cereals are readily matured. Additions have been made to the buildings and a beginning made in animal industry. A record was kept of the milk yielded by a cow purchased for the station, which shows that over 29 pounds was produced daily from native pasture grasses during the months of June, July, and August.

At the Rampart Station the work begun in 1901 was confined to the growing of a few varieties of cereals, all of which matured finely. Winter rye sown from seed matured in 1901 successfully passed through the winter and matured a crop of fine grain. These results, attained at a latitude of 65° 30′ N., aid in demonstrating some of the agricultural possibilities of the country. Cooperative experiments have been carried on by Rev. C. P. Coe, who is in charge of the Baptist Orphanage at Wood Island, and these experiments have been conspicuously successful. Winter rye, spring wheat, barley, and oats were matured and a good start made with various tame grasses and other forage crops. Hardy vegetables were produced in considerable quantity, a sufficient amount being grown to supply the 40 members of the orphanage and leave a surplus for sale.

At the Sitka station considerable work has been done in finishing the headquarters building and in enlarging the farm buildings. A small nursery has been established, and several hundred apple trees and current, raspberry, and other shrubs are being grown for distribution when their adaptability has been demonstrated.

During 1904 efforts should be made to reopen and equip the station at Rampart. The conditions here are representative of the largest body of agricultural land in Alaska and embrace many thousands of acres.

At the Sitka station additional buildings are needed, and there is a demand for a scientific equipment, which should include a chemist, a botanist, and an entomologist, with the necessary laboratory equipments for their various lines.

It is highly desirable that work should be taken up with live stock, but at present this can be done only on a limited scale. The special agent in charge of the station has recommended the establishment of a temporary cattle ranch on Kodiak Island with a view of introducing some of the hardier breeds of cattle into Alaska. He believes that the Galloway breed is adapted to the conditions in that territory and that southwestern Alaska is particularly suited to this investigation. For a number of years Congress has appropriated for the introduction of reindeer into the more northern part of Alaska, and it seems possible that in a similar way provision might properly be made for the introduction of cattle into the southwestern grass region.

HAWAII EXPERIMENT STATION.

The work of the Hawaiian Agricultural Experiment Station has been continued along the various lines of investigation previously described. Additional portions of the station land have been brought under cultivation, and additions have been made to buildings, fences, irrigation plant, etc., as occasion required and funds permitted. A special effort is being made to build up a working library, and the special agent in charge has contributed his private collection as a nucleus for a station library. The necessity for a well-equipped economic library is peculiarly felt in a region as isolated from library facilities as is this station.

During the past year a number of bulletins have been issued, giving the results of investigations which have thus far been carried on. The experiments begun in the previous year on taro rot and potato rot have been continued on an enlarged scale, and the results already obtained suggest the practicability of combating these diseases. One of the most destructive diseases of the taro may be prevented by proper attention to the irrigation water and to the application of suitable fertilizers. The potato experiments have been continued, and it is found that one form of rot may be successfully combated by the thorough use of Bordeaux mixture, and preliminary experiments seem to indicate that a second disease, which is due to a soil fungus, may be prevented to a very great extent by soaking the seed tubers in a solution of formalin and planting them in uninfested soils. These experiments are to be continued for a number of years in the hope that the results obtained in the preliminary investigations will be confirmed.

Formerly, the growing of corn was an important industry in Hawaii, but through careless methods of cultivation and the attacks of insects the growing of this crop has become an uncertain industry. Investigations have been begun by the station in which the effect of deeper plowing, the use of fertilizers, thorough cultivation, and the introduction of new varieties are tested. The preliminary results thus far obtained have given excellent results and two varieties which have been introduced—Leaming and Boone County White—seem to indicate that these varieties are particularly adapted to cultivation in Hawaii and are apparently more satisfactory than the so-called native varieties.

A collection is being made of the grasses and forage plants of the islands, and it is hoped that a bulletin may soon be issued concerning them, which may contain notes on the native and introduced species, together with suggestions relative to their value for different purposes.

The investigations on injurious insects have been continued, and a serious outbreak of a mealy bug on alligator pears was prevented by prompt action.

The station is devoting considerable attention to the subject of fiber plants, and a bulletin has been issued on the sisal hemp in Hawaii and investigations are being carried on with Manila hemp and other fiber-producing plants.

Experiments with tobacco, especially with Sumatra leaf tobacco, grown in partial shade furnished by light cloth, have been apparently very successful and will be continued upon a larger scale. It is believed that there are a number of localities where Sumatra tobacco can be grown under shade at a decided profit.

PORTO RICO EXPERIMENT STATION.

Since the last report from the Porto Rico Agricultural Experiment Station a permanent location has been secured adjoining the city of Mayaguez and the station removed from its temporary location at Rio Piedras. The farm on which the station is situated had not been in cultivation for some time and a considerable portion of the season was taken up with clearing the land of shrubs and weeds, repairing buildings and roads, constructing fences, digging ditches, etc. As preliminary to planting, a number of acres was sown with general crops in order to bring the soil in condition for experimental purposes and incidentally test the adaptability of the different plants to Porto Rican conditions.

A beginning has been made to establish nurseries of citrous fruits and rubber and tea plants, as well as varieties of mangoes, bananas, and other tropical fruits. Arrangements have been made by which improved varieties of tropical fruits are being secured from different portions of the West India Islands through the courtesy of the commissioner of agriculture for the British West Indies.

Experiments have been commenced to test various fiber plants, and there are now growing at the station Manila hemp, sisal hemp, and a number of species of fiber plants which grow upon the island. Experiments are being conducted to test the value of various leguminous crops for restoring the soil, and thus far velvet beans and soy beans appear very promising. Cowpeas, which had been extensively sown, suffered severely from insect injuries. Alfalfa is also being tested with some promise of success.

The coffee investigations of this station have been continued at the coffee plantation La Carmelita. On this estate 10 acres have been placed at the disposal of the station for experimental purposes, and the effect of different methods of pruning, shading, fertilizing, etc., are being tested.

During the early part of the fiscal year the botanist of the station visited the northeastern part of the island and made a report upon the native forest, which was fast disappearing. Based upon this preliminary survey a recommendation was made to the Secretary of the Interior that a forest reserve be set aside, and in January, 1903, the President proclaimed the Luquillo Forest Reserve of about 25,000 acres.

For continuing the investigations in 1904 the insular government appropriated $2,700. This will be largely expended on permanent improvements and special investigations. Tobacco investigations and a soil survey of the island have been begun, but owing to the small appropriation the work could be but little more than a preliminary survey. It is desired that this work should be continued in cooperation with the Bureau of Soils of this Department, and it is recommended that the present law, which limits the soil investigations to the continental portion of the United States, be amended so as to permit of an extension of the work in both Porto Rico and Hawaii.

The cordial support which has thus far been accorded the station by the insular legislature, together with the interest manifested by planters in requesting its publications and in soliciting specific information, is very encouraging and bespeaks for the station a high degree of usefulness.

INVESTIGATIONS ON NUTRITION OF MAN.

During the last fiscal year the inquiry regarding the food and nutrition of man has been conducted along the same general lines as formerly, and has included studies of the nutritive value and cost of different food materials in various regions of the United States, special investigations with the respiration calorimeter on the transformation of matter and energy, studies of the changes brought about in cooking, the relative digestibility of different food products, and dietary studies.

Meats, legumes, cereals, fruits, and nuts have been the special subjects of the digestion experiments of the past year. The work with meat has included the study of the influence of cooking, as well as of age, breed of animal, etc., upon digestibility. The experiments with cereals have included the effect of the different methods of the milling of flour upon the digestibility of bread made from it.

Cooking experiments have been made only with meat and have included a study of the effect of cooking upon the flavor, palatability and digestibility, beef being usually used for the purpose. Generally speaking, the meat was cooked in a number of ways, the length of time of cooking, the temperature, etc., varying in the different tests. It was found that the chief loss in weight during the cooking of beef, and doubtless of other meats also, is due to the driving off of water. When beef is pan broiled there appears to be no great loss of nutritive material. When beef is cooked in water from 3 to 20 per cent of the total substance is extracted and found in the broth. The amount of fat thus recovered varies directly with the amount originally present, i. e., the fatter the meat the greater the quantity removed. The amount of water lost during cooking varies inversely as the fatness of the meat, i. e., the fatter the meat the less the shrinkage due to loss of water. In cooking in water the loss of constituents is inversely proportional to the size of the piece of meat.

Dietary studies have been made in several widely different localities, and have included a study of the amounts of food consumed by people of varying occupations, age, sex, and circumstances. The purpose has been to secure data in regard to the kinds, amounts, and costs of food materials under different conditions, to give an opportunity for comparison with the data obtained by investigators in other countries, and to assist in establishing a general dietary standard. As a whole the experiments have given valuable results.

In accordance with the usual plan the investigations have been carried on in cooperation with agricultural experiment stations, agricultural colleges, and other educational institutions in different States, including California, Connecticut, District of Columbia, Georgia, Illinois, Maine, Minnesota, and Tennessee.

Nine dietary studies and thirty-one digestion experiments were made with fruits and nuts, these articles in nearly every case constituting all or almost all of the daily fare. The results obtained warrant the deduction that, as shown by their composition and digestibility, both fruits and nuts can be favorably compared with other and more common foods.

IRRIGATION INVESTIGATIONS.

The work of this branch of the Office of Experiment Stations during the past year has included:

The furnishing of information regarding the requirements and possibilities of irrigation, in both the arid region and the East, to a large number of farmers who either contemplate emigrating to the West or adopting irrigation as an aid to agriculture in the East.

The making of special studies and furnishing expert advice to communities about the methods of distributing water to lessen losses from seepage and evaporation, and about the preparation of plans for draining land in both the arid and humid parts of the United States.

The making of original investigations in order to discover the best methods of handling water and thus promote the largest and best development of the country, and to gather the facts needed to answer the inquiries which come to the Department. These may be grouped under the following heads:

In the acts making appropriations for these investigations Congress has provided that wherever possible the Department should cooperate with agricultural colleges and experiment stations in the several States. Experience has shown that this is a wise provision, as it enables this Department and the State stations to obtain much larger results than would be possible if each carried on its work alone. It is believed that the arrangement is equally advantageous to both parties. In accordance with the provisions of this act we have made arrangements for cooperative work with a number of the experiment stations of the East, where irrigation problems are assuming considerable importance, and with all of the experiment stations of the arid region, except two. In three States special appropriations have been made by the State legislatures to aid in extending this cooperative work. The Department is also receiving appreciated aid from the various State engineers' offices of the arid States.

DUTY OF WATER.

At the outset of these investigations the Department made an extended study of the quantity of water being used in irrigation under existing methods. This knowledge was needed by courts in the establishment of titles to water, by canal companies in planning and operating irrigation works, by farmers in making water-right contracts or in building ditches for themselves, and it was also an indispensable basis for an intelligent effort to bring about a more economical use of water by the improvement of methods, as well as to furnish advice to the large number of persons who each year undertake irrigation for the first time.

The work of the past year and that planned for the future is to promote the adoption of improved methods. It includes the determination of the amount of water needed to give the best results, the time when it should be applied, and the methods of application best suited to different localities and different crops. In this investigation experiments are being made in which the water actually used by plants is being measured. With this as a basis, the additional quantities necessary to supply evaporation and other losses, which are unavoidable under any conditions, can be determined with greater exactness. The same problem is being taken up from the practical side. Experimental fields have been planted. In these fields different quantities of water are being applied to crops where all other conditions are made as nearly uniform as possible. In this way a quantity of water which will produce the largest returns can be determined.

A prominent feature of the reports made by our agents in 1902 is a discussion of the evils resulting from the use of too much water, the swamping and ruining for the present of large areas which were only a few years ago highly productive farms. The first remedy which suggests itself is to stop using more water than is necessary, and the work of the Department just outlined is for the purpose of determining what is necessary. Farmers can not make these experiments for themselves because they are dependent upon what they grow for a living and must apply enough water to make sure of the crop. It is, therefore, the duty of this Department to make the experiments, and the benefits certain to accrue fully warrant the outlay. The use of water in excess of the needs of crops not only reduces the yields and ruins large areas of fertile lands, but it deprives other lands equally fertile of a water supply. There is an area of approximately 10,000,000 acres now under irrigation, and canals already built cover an added area of at least 5,000,000 acres. Our work in the past leads us to believe that the use of better methods on the areas now irrigated will make possible the cultivation of the added 5,000,000 acres now under ditch with very little added expense for canal construction. Reduction of yields by the failure to use the proper quantities of water is reason enough to justify the work being done on this line, but the damage done by the surplus makes the continuation and enlargement of this work of great public interest.

The work so far outlined deals with those parts of the United States where no crops can be raised without irrigation. Scattered throughout the arid States, and in the regions between the Missouri River and the Rocky Mountains, there are large areas where crops can be raised without irrigation, but where the productivity would be greatly increased by the use of more water and by methods of cultivation which will conserve the supply of moisture which they already have. The agent in charge of our work in Oregon estimates that there are 3,000,000 acres of agricultural land in that State whose products can be greatly increased by the adoption of proper methods for conserving the moisture which falls outside of the irrigation period, and equally good results can be obtained in other States. In Kansas the best methods of utilizing small sources of water supply are being studied, and experiments are being carried on.

SEEPAGE.

Measurements of former years have shown that the losses from canals by seepage are much greater than have been commonly supposed. The Department is carrying on a series of investigations to determine the best means of preventing these losses. Measurements of a large number of canals show that as a rule the greater losses occur in the comparatively short sections. If these sections could be improved, the leakage would be greatly reduced. In many cases irrigators do not make use of more than 50 per cent of the water entering the headgates. The saving of these waters, therefore, means an increase of more than 50 per cent in the available supply, or the doubling of the area irrigated, but the benefits to come from this saving will be more than this gain in crops and in watered area. Seepage water from canals and laterals not only often finds its way where it can not be available for irrigation, but it also prevents the cultivation of large areas of land through the rise of ground water until the land becomes too wet for crops. This also brings up the alkali which has been dissolved and makes the land still further unfit for cultivation. The facts being gathered enable the Department to advise farmers and canal managers as to the best plans for distributing water to their fields at the least expense and with the least loss.

Leakage from ditches is a very serious question in the extension of irrigation in the eastern part of the United States. It has been found practically impossible to irrigate the sandy lands of Florida by unlined earthen canals, as the water all sinks before it reaches the grounds to be irrigated. There has been a similar experience in both Winconsin and New Jersey, and experiments are being made to determine whether or not some cheap and feasible system of lining canals and distributing water can be found.

DRAINAGE.

Requests from communities for advice about the removal of seepage water have been so numerous during the year that it has been beyond the means of the Department to respond to all of them, and it will be necessary to extend this work in the future. There is a special reason why the Government should lend this aid. The injury to each farmer's land does not come from his own neglect or wasteful use, but from the watering of other areas, which action is being encouraged by the Government, so that the individual settler in many instances is a victim of the country's growth and of a recognized State and National policy.

Numerous requests have also come to this office for advice about agricultural drainage in the eastern part of the United States, and especially in the South and Middle West, where there are large areas of fertile land which, if drained, could be made immensely productive. The drainage of such lands is beyond the means of the individual settler. The public welfare will be greatly promoted by having this work done. Every consideration which justified the extension of aid in the reclamation of arid lands applies with equal or greater force to the furnishing of needed advice about the reclamation and improvement of this overwatered land, because it would have exceptional value. Its fertility has not been exhausted by long cultivation, and it is located where transportation is cheap and where there is direct access to densely populated districts. The farmers are there, the markets are there, and the soil is there. In the aggregate, these swamped areas have a productive capacity equal to four times the State of Illinois, and the inauguration of their improvement takes rank among the important public agricultural movements of the country.

IRRIGATION IN THE EASTERN PART OF THE UNITED STATES.

Irrigation in the humid portions of the United States is proving profitable and is becoming an important factor in the production of certain crops. The irrigation of rice in Louisiana and Texas has added largely to the prosperity of those States and is being rapidly extended. The methods employed differ widely from those used in rice irrigation along the Atlantic seaboard, and the Department is aiding farmers by gathering data as to the quantity of water needed, the best methods of raising it from streams, the cost of pumps, engines, fuel, the construction of laterals, and time and method of applying it. In the South Altantic States rice culture is having to contend with some troublesome conditions created by the cutting off of the forests on the headwaters of streams. This has filled river channels with the soil washed from the hillsides, and has forced rice growers to contend with a wider fluctuation in streams. A partial investigation of the problems confronting the rice growers in this section has been made to determine the feasibility of providing a supplemental water supply in times of scarcity and also to advise the farmers regarding the best means of protecting their dikes from floods.

An investigation of the requirements of cranberry irrigation is being carried on in cooperation with the State Experiment Station of Wisconsin. This investigation includes a study of both the irrigation and drainage requirements of this crop. The success of the cranberry industry depends upon the proper use and control of water. It must be applied at the right time, and it must be withdrawn quickly at the right time. Until the last few years no attempt was made by cranberry growers in Wisconsin to exercise control over the water. If nature failed to cover the vines at the right time or uncovered them at the wrong time the crop would suffer. The severe drought of 1895 almost destroyed the industry in that State. With its revival better methods are being adopted; dams are being built to collect the surface water; canals are being constructed to carry water pumped from streams. The development of the industry and the extension of the area under cultivation have brought new difficulties. More water is needed, requiring larger ditches. Greater uniformity in the matter of drawing off water is imperative to prevent the operations of one neighbor damaging those below him. Much litigation has been caused by a lack of arrangements for cooperation and by the construction of inadequate works. This calls for more knowledge as to the principles which should govern in this work, which this Department is endeavoring to collect and provide.

The results of the present year, while not conclusive, show how greatly the success of this industry will be promoted by an efficient system of canals for getting the water onto the ground and getting it off. On June 11 of this year there was danger of frost. Those who had proper ditches saved their crops. Those who were not so provided lost them. A conservative estimate of the loss in the Cranmoor and Mather regions places this loss at $25,000. The damage due to improper drains in this region which prevented the removal of the water in time was greater than that from frost, so that from these two items in the two districts there was a net loss this year of over $75,000, a sum which would probably be nearly sufficient to construct a system of canals to meet the demands of both districts.

The severe drouth which prevailed in the New England and North Atlantic States during the early part of the present summer not only showed the importance of irrigation to market gardeners and others growing high-priced products in this part of the country, but gave an excellent opportunity for observing the effects of irrigation where it was made use of. The facts regarding the operation of a considerable number of private irrigation plants have been collected and will be published for the information of others wishing to undertake similar work. There were also carried on in New Jersey some systematic studies of the effect of irrigation upon asparagus, other vegetables, and small fruits, and on the sandy lands in the southern part of the State.

FOREIGN STUDIES.

The law requires that this Department shall investigate irrigation methods and laws of foreign countries. A report on Egyptian irrigation has been published, and during the past year a study of the methods of operating canals and distributing water among farmers in Italy has been made. Both of these have shown that foreign countries have many ideas and practices which we can study to advantage, and these studies of foreign systems should be continued until our farmers are informed as to the methods of every country in the world where irrigation is practiced.

AGRICULTURAL ENGINEERING.

Attention has been previously called to the importance to American agriculture of bringing about improvements in our practice along a number of branches of engineering. But so pressing has been the demand for investigation relating to irrigation that it has not been possible, with the funds at the command of the Department, to do any considerable amount of work in other lines of agricultural engineering. The studies in drainage, apart from those relating to irrigation, which it has been possible to make, have been of great value to a number of districts in the East, and these should be extended.

The studies of pumping should also be extended, in order to answer more definitely the many inquiries which are coming to the Department for information and advice. Already thousands of farmers are pumping water for irrigation and thousands of others are thinking of doing so. They write to this Department asking the amount of water required and the size and kind of pumps necessary to furnish it. It is certain that irrigation by pumping will greatly increase in the future, and the money value to farmers of having pumps operated efficiently will be proportionately enhanced. Pumping is also being used to relieve land which has been injured by seepage, and altogether this field is one of the most promising in which we are engaged, and nothing should interfere with continued work on this line.

While the study of power is being made primarily with relation to its use in running pumps, the information collected will prove useful in other lines of farm work. The long-distance transmission of electricity has made it possible to utilize the power of streams so cheaply that it can be profitably applied to many classes of farm work. Competition makes it necessary for our farmers to adopt every means of cheapening production, and the use of this power for operating farm machinery promises much in this line. Power has been largely used on great ranches, but has not been adapted to the needs of the man who is farming on a small scale and doing his own work. The work now being done by this Department is of especial value to this class of home-making farmers, as it will help to put them in a position to compete with those who can take advantage of the economies made possible by doing things on a large scale.

Closely related to this has been the growing interest in a number of our strongest agricultural colleges in the development of courses of instruction in farm mechanics. The increasing use of large, complicated, and expensive machinery in connection with farm operations has led to a demand on the part of the students attending the agricultural colleges for definite instruction regarding the construction and use of such machinery. Important problems regarding the further application of steam, gasoline, electricity, and other kinds of power to farm purposes are also being brought home to these institutions to solve in the interests of our farmers. The manufacturers of farm machinery, realizing that experts trained in the science and art of agriculture as well as in mechanics and engineering would make their most efficient helpers, are beginning to look to the agricultural colleges for such men. The colleges attempting to establish courses in farm mechanics and other lines of agricultural engineering are immediately made aware of the fact that the data for the scientific and pedagogical basis of such courses are very meager, and they are therefore looking to this Department to aid them in instituting investigations to supply this information. Since it has seemed to this Department that this field of investigation was clearly within the scope of existing law, it has begun to aid the colleges along this line. With our present resources only a very limited amount of work in this line can be undertaken, and I have therefore recommended that $10,000 be appropriated to enable this Department to extend its operations in agricultural engineering, especially on the application of power to farm machinery.

In order that the work of this Department in lines of agricultural engineering other than irrigation may be more definitely recognized, and organized on a more permanent and satisfactory basis, I recommend that Congress change the wording of the appropriation act so as to make the general title of this division of our work "Irrigation and Agricultural Engineering."

OFFICE OF PUBLIC ROAD INQUIRIES.

The National Good Roads Convention held at St. Louis, Mo., April 27 to 29, 1903, in connection with the opening of the Louisiana Purchase Exposition, was probably the most important meeting of the kind ever held in the United States. It brought together a greater number of influential citizens than any previous road convention. Addresses were delivered by the President of the United States, several governors of States, and members of Congress, besides prominent men engaged in agricultural and commercial pursuits, railway transportation, and journalism.

The work of testing the chemical and physical properties of road-building materials has been continued by the road-material laboratory, which is conducted in the Bureau of Chemistry in cooperation with the Office of Road Inquiry.

COOPERATIVE FIELD WORK.

The cooperative field work of the Office deserves special mention. Work of this kind usually results from an invitation extended to the Director by local or State authorities, an agricultural experiment station, or a good roads association. The Department furnishes only the services of its road experts. The materials are supplied, and the expenses of the work paid, by the other factors in the cooperation. The machinery employed is usually furnished free of charge by the manufacturers, who thereby secure an advertisement of their wares; and the railroad corporations usually transport such machinery free on account of their interest in road improvement as a means of developing the country tributary to their lines. The end in view is the construction of a short section of object-lesson or experimental road.

Such work furnishes opportunity to test local road-building materials, and gives the people of the locality an object lesson in methods of preparing the material and constructing the road; and the finished road serves to teach the worth of a good hard road to all who travel over it. In nearly all cases the value of such work is greatly enhanced by the holding of a convention while the work is in progress. This brings together a large number of persons, who not only secure the benefit of the object lesson, but who listen to addresses on all phases of the road question.

Cooperative field work of the kind just described has been carried on to a greater or less extent during the last five years, and its practical value has been amply demonstrated. It certainly yields a maximum of good results at a minimum of expense to the Government. The Director of the Office has recently secured reports from many localities where experimental road work has been done, and they uniformly show that the work was well done and that the object-lesson roads built led to a general improvement of the roads in those localities. During the past year more cooperative field work has been done than in any preceding year, and the demand for Government aid of this kind is greater than ever before.

For greater convenience and efficiency in carrying on the field work of the Office, the country has been laid off into four main divisions, with a special agent in charge of each.

GOOD ROADS AND RURAL FREE MAIL DELIVERY.

The intimate relation which exists between good country roads and rural free delivery of mail can not be too strongly emphasized. Communities which would enjoy the latter must make and maintain the former. In many instances bad roads have prevented the extension of rural free delivery to communities where it was greatly desired, and in some cases have caused suspension of routes already in operation. The desire for extension of the service should, and doubtless will, act as a powerful stimulus to road improvement in many localities.

The work of the Office of Public Road Inquiries appears to be no longer of a tentative character. Year after year it assumes increased importance and wider scope. That it will be a permanent feature of the Department's work hardly seems open to question.

DIVISION OF ACCOUNTS AND DISBURSEMENTS.

The extension and rapid growth in the work of this Department necessitates an increase in the estimates for each year. These estimates are prepared in the Division of Accounts and Disbursements and transmitted to the Congress through the Secretary of the Treasury and all expenditures are made under the supervision of that Division. The appropriations for the fiscal year ended June 30, 1903, including $510,000 for deficiencies, were $5,013,960, an increase of $1,091,231.54 over the preceding year. The expenditures during the year amounted to $4,296,882.60, leaving a balance of $717,077.40, but, the greater part of this sum is covered by outstanding liabilities.

All accounts for the fiscal year 1901 having been settled, the unexpended balances of appropriations for that year, amounting to $65,127.50, were covered into the Treasury on June 30, 1903.

There was received and deposited in the Treasury the sum of $12,803.56. Of this amount $4,026.69 were received from the sale of American products in Europe, $382.75 from sales of agricultural products of the agricultural experiment station in Hawaii, $782.45 from the station in Porto Rico, and $548.15 from sales of experimental shipments of fruit to Europe.

The amount paid for rent of buildings in the District of Columbia for the use of the several branches of the Department was $21,700. The amount appropriated for the same purpose for the current fiscal year, 1904, is $27,900, an increase of $6,200.

DIVISION OF PUBLICATIONS.

The work of the Department of Agriculture in all its branches is necessarily reflected in the work of the Division of Publications. As all the other bureaus and divisions contribute to the acquisition of information, so the Division of Publications is the channel for its diffusion. Therefore, no possible enlargement of the work of the Department in any particular branch can be conceived of which does not ultimately add to the work of the Division of Publications. It is not within the province of its chief to restrict its work, but only to direct and control it to the best of his ability and with the means at his command. These facts explain quite logically the continued growth in the work of this Division.

Until last year the largest number of publications issued in any twelve-month period was 757 in 1902. The total number of publications issued during 1903, however, was 938. Of the publications issued in 1902, 355 were new. The new publications issued in 1903 amounted to 375, showing that the bulk of the increase in the number of publications issued consisted of reprints, which in turn indicates a continued and pressing demand for the Department publications. While the new publications show but a small increase in number, the number of pages they contain shows an increase of 17 per cent over 1902. The total number of copies of all publications issued during the year aggregated not far from 12,000,000.

The publications known as Farmers' Bulletins seem to satisfactorily supply a widely felt want. Of the total number of copies of all publications issued during the year nearly 7,000,000 were Farmers' Bulletins, and of these nearly 4,000,000 copies were distributed, as provided by law, under addressed franks supplied by Senators, Representatives, and Delegates.

In spite of the generous supply of publications, it is constantly necessary to refuse requests, owing to the editions being exhausted and means lacking to furnish a further supply. Under these circumstances I have found it desirable to restrict free distribution abroad to Government and other public institutions and to a few persons engaged in lines of work analogous to our own and actually cooperating with us.

The figures showing the number of publications issued and distributed by the Department would suggest to casual observation that the number was amply sufficient to supply all possible demands. Such, however, is far from being the case. A careful consideration of the applications received afford conclusive evidence that only a comparatively limited number of the nearly 7,000,000 farms in the United States are reached by the publications of this Department. This is a matter of regret, as the full value of the information acquired by the Department can unquestionably be realized only by a prompt and widespread diffusion to all those who might be benefited by it. It is a striking evidence of the general appreciation of the information the publications of this Department contain that over 30,000 copies were sold by the Superintendent of Documents in the face of the enormous free distribution, and that official has moreover declared that the number sold would be twice as great were he able to supply the demands. This suggests the desirability of setting aside, to defray the expense of reprints, the sums received by him for publications sold through his office.

The conservative course recommended by yourself in the matter of illustrations has been carefully followed, the rule adopted being to exclude all illustrations not necessary or at least essentially helpful to the understanding of the text. It is impossible for this Department, for reasons sufficiently obvious from what has already been said, to further restrict the output of publications. In view of the increase in the work of the Division of Publications and the causes which promise its continuance in the future, I have felt constrained to recommend some increase in the appropriations for its use.

THE LIBRARY.

The work of the Library increases from year to year with the growth of the Department, and with increased appropriations it is better able each year to meet the varied demands made upon it. The collection of books and pamphlets now in the Library numbers about 80,000, and contains many books and periodicals found in few, if any other, libraries in the country. Agricultural workers in all parts of the country look to this Library more and more for assistance in the way of loans of books, verification of references, and preparations of subject lists.

ACCESSIONS.

A larger number of purchases have been made during the past fiscal year than in any year previous. Many new scientific serials have been added to the list of subscriptions, and the list of general agricultural, technical, and scientific periodicals acquired by gift and exchange has been largely increased. The present policy of the Department in the distribution of its documents enables the Librarian to arrange exchanges with many foreign as well as American scientific institutions and societies whose publications form valuable additions to the Library.

TECHNICAL WORK.

The Library has continued the publication of its quarterly bulletin of accessions. The recently adopted subject arrangement of the bulletin has proved to be an added convenience for reference use. Beginning with December, 1902, catalogue cards for current accessions to the Library have been printed at the Library of Congress. Extra copies of these printed cards can be purchased at small cost on application to the Librarian of Congress. A reprint of the index cards for the Yearbooks and the Farmers' Bulletins is in progress to meet the demands from the smaller libraries in the country for indexes to these popular publications of the Department. Provision has also been made for extending this index work to include index cards for some of the most important agricultural periodicals. During the past year there have been requests from several agricultural colleges and experiment stations for suggestions and aid in reorganizing their libraries. Assistance of this kind has been given whenever practicable, and the Department will continue such aid to further the organization and development of agricultural libraries.

NEW BUILDINGS FOR THE DEPARTMENT.

It is gratifying to announce that Congress, at its last session, authorized the expenditure of $1,500,000 for the erection of new buildings for this Department. Two hundred and fifty thousand dollars was appropriated to inaugurate the work and as soon as the money became available steps were taken to secure the necessary plans and specifications. At the outset, some difficulties were met in the matter of reaching satisfactory conclusion with the architects. These matters were not finally settled until early in September of this year, when the contract for the preparation of plans and specifications was awarded to the firm of Rankin, Kellogg & Crane, architects, of Philadelphia.

The Department is now occupying 137,963 square feet of net floor space, 75,771 square feet of which is in rented buildings. In order to accommodate the present needs of the Department alone this amount of space would have to be increased fully 25 per cent. The Department of Agriculture is different in its requirements, so far as buildings are concerned, from other branches of the Government. Our work is largely of a research nature. Laboratories, therefore, are essential and form a considerable portion of the room required. A committee of Bureau chiefs in the Department, consisting of Doctors Galloway, Salmon, and True, has given careful consideration to the varied needs and have made recommendations, which I approve, that the best interests of the Department will be subserved by providing for a series of buildings connected with pavilions in such a way as to make practically one harmonious structure. The chief advantage of this plan is that it can be laid out in such a way as to be added to indefinitely from time to time, as the needs of the Department grow. These ideas formulated by the committee have been further developed by the architects, with a result that a series of buildings has been designed, the central feature of which is an administrative structure. Grouped about this are laboratory buildings to be used by the large bureaus in their research work.

The scheme, as a whole, provides for the erection of ten buildings, all suitable for the class of investigations which the Department must necessarily carry on. The amount authorized by Congress will suffice for the erection of three of the laboratory buildings, but it will not be sufficient for the erection of the administrative structure. The three buildings will have in them floor space of 100,000 square feet and will enable the Department to comply with the law, in so far as bringing within these structures all those branches of the Department that are now paying rent. The three buildings contemplated will be completed within the appropriation authorized according to the estimates secured at the present time.

CRISIS IN COTTON PRODUCTION.

The invasion of the cotton boll-weevil has been a special menace to our cotton crop, and has done more than anything else to awaken widespread apprehension as to the future of this most important crop. The boll-weevil first appeared in the State of Texas in 1894, and from that time on has been under observation and investigation by the Department through its Division of Entomology. It was not until 1902, however, that this branch of the Department was able to undertake anything like thorough and systematic work in the matter of studying this very destructive enemy of cotton. In 1903 the scope of the work was further enlarged, an appropriation of $20,000 being made in the Division of Entomology for the investigations. Aside from this work the Bureau of Plant Industry has, during the past year, been carrying on considerable work with a view to securing, if possible, early and resistant varieties by breeding and selection; and has been conducting some more or less general experiments in the matter of crop diversification at special points in Texas. It has also been engaged in distributing a considerable quantity of cotton seed of early maturing and promising sorts.

The work of the Division of Entomology has shown conclusively the value of good cultural methods, the planting of early-maturing varieties, and the destruction of weevil-infested material, this conclusion having been reached only through the careful and detailed studies of the life history and habits of the insect. The demonstration work along these lines, which the Division carried on the past year, has been exceedingly promising, as it has been shown that cotton can be grown in remunerative quantity, despite the presence of the weevil. Notwithstanding what has been accomplished by the Department, however, the fact remains that the boll weevil is constantly spreading north and east, and it is probably only a question of time when it will reach all of the cotton-growing States. Thus the country is confronted with a very grave problem, as the invasion of this insect must necessarily mean a complete revolution in present agricultural methods. During a recent visit to some of the Southern States considerable time was spent in the weevil-infested district, and from the facts gathered in this way I am convinced that energetic measures must be adopted to meet the present emergency. After thoroughly canvassing the situation with representative men in Congress and with others, I am of the opinion that a cotton investigation fund should be appropriated and set aside for immediate use in connection with this most serious problem. In order to make the work comprehensive and thoroughly effective, I am of the opinion that a sum not less than $500,000 should be made immediately available for this purpose, the same to be expended under the direction of the Secretary of Agriculture, in such manner as will give the most immediate practical results. As to the problems which might be handled by the Department with such a sum available, I would respectfully call attention to the following:

RECOMMENDATIONS.

1. CHECKING SPORADIC OUTBREAKS OF THE WEEVIL.—It would seem highly important that some action be taken looking to the checking, if practicable, of sporadic outbreaks of the weevil in the territory

immediately adjacent to that now infested. This could best be accomplished by the organization of a corps of competent entomologists and could be carried on in cooperation with the State authorities. In order to make this work thoroughly effective it will be necessary for the States interested to enact proper legislation. This is a matter that could be handled and guided by those in authority, working under the direction of the Secretary of Agriculture.

2. Demonstration Work to Show the Value of Improved Cultural Methods by Which Farmers can Produce Fair Crops in Spite of the Weevil.—This is the most promising field for immediate relief, and owing to the fact that the weevil is so far confined to Texas, the work here outlined would necessarily be limited more or less to this State, although regions in adjacent territory should also have such investigations carried on in them in order that the people may become enlightened in advance of the insect's ravages. The object and scope of the work would be to show by actual demonstration experiments the value of better cultural methods, the value of early maturing varieties, and the value of and necessity for complete and thorough destruction of all infested material. To carry out this work thoroughly and effectively would require a corps of men familiar with cultural conditions, and who have the knowledge and ability to direct the necessary specific work that might be ordered by the Secretary of Agriculture. Legislation would be required in this case, also, to enforce the destruction of infested material; but, under proper organization, this could be brought about.

3. Work having for its Object the Production of New, Early, and Improved Varieties of Cotton.—The value of early varieties has been demonstrated, but most of them have serious drawbacks in that they are poor yielders and the lint drops out easily during storms. These matters may be corrected by proper breeding and selection, and one of the important problems would have for its object the taking up of this work on a systematic scale, to the end of securing sorts which would not only be early, but would be storm-proof and resistant.

4. Studies of Cotton Diseases.—While the boll-weevil is mainly in the public eye at present, the fact remains that other serious pests of cotton cause great losses annually. It is natural to attribute all losses at the present time to the insect in question, whether these losses be from other insects, diseases, floods, droughts, or whatever source. Reliable studies indicate that the loss in Texas alone from the so-called root-rot disease will, in all probability, aggregate several millions of dollars annually. This and other diseases should be thoroughly studied, and corrective measures should be adopted.

5. Cotton Insects.—What is said of cotton diseases is also true of cotton insects (especially of the boll-worm) other than the boll weevil. These should all receive careful attention, and practical experiments should be carried on with a view to lessening the injury caused by them.

6. Introduction of New Crops.—The urgent necessity for the introduction of other crops which will take the place of cotton can not be too strongly emphasized. Cotton, of course, should be grown, but the time is evidently at hand when a concerted effort should be made to bring about a change in Southern agricultural conditions in the

direction of greater diversification. This is recognized now as a vital question in the South. In many sections already the yield of cotton is barely profitable, so that, when the reduction due to the boll-weevil and other pests is taken into account, it will be necessary to abandon cotton growing altogether; while the decreased yield in the best districts of the cotton-growing sections renders it more important that other crops should be grown. Such crops as alfalfa, sorghum, Kafir corn, and cereals of various sorts should all receive attention, not only for silage, pastures, and winter forage generally, but for green manures as well.

7. Studies and Experiments in Connection with Methods for the Destruction and Control of the Boll-Weevil, and Other Cotton Insects.—It would seem highly important that the Government should take cognizance of the many devices which are being placed on the market for combating the weevil and other insects. This is necessary, as much for positive as negative results. Hundreds of devices and nostrums are offered to the public, and people are led to spend money for them. The Government should be in position to determine, once for all, the value or nonvalue of such devices, and thus be able to definitely and positively advise on all matters of this kind. Aside from this, the Government should take the matter of mechanical devices under thorough consideration, and should encourage, by the utilization of mechanical experts, the construction and use of everything which gives promise of practical value.

8. Studies of Enemies of the Insect.—While the studies of the enemies of the insect have had, so far, no practical result, there is no doubt that this work should be continued, and everything in the nature of enemies, whether they be predaceous or parasitic insects, birds, fungus parasites, or others, should receive careful attention.

9. Securing and Distributing Seed of Cotton Known to have Special Value for Earliness and Ability to Resist the Weevil.—Systematic action should be taken in the matter of securing from every source available seed of promising varieties and thoroughly testing them in the weevil-infested district. In addition to this there should be a systematic endeavor to bring together desirable varieties from all available sources for advance trials in the sections where the insect is likely soon to make an invasion.

10. General Propaganda.—Under this head there should be organized a competent corps of efficient workers, who could, with the cooperation of the agricultural colleges, farmers' institutes, State boards of agriculture, and all such organized bodies, bring to the attention of planters everywhere the latest results as to methods of meeting the present emergency.

To carry out the foregoing work effectually, it is believed that the best results will be secured by a separate organization. It will be seen that the two branches of the Department primarily interested in this matter are the Bureau of Plant Industry and the Division of Entomology; and their officers and men would be in position to effect the proper organization and to direct the main features of the work. I would, therefore, respectfully recommend that, if the amount already mentioned be set aside as a cotton investigation fund, the Secretary of Agriculture be authorized to take such steps in the perfecting of a proper organization for handling the work as, in his judgment, may be best. Owing to the very nature of the investigations, and the fact that they will involve most thorough and far-reaching scientific work, the management of the general plans must necessarily rest with the Department. It is believed that the work can be strengthened by securing the advice and cooperation of one or two thoroughly practical men in the States most directly interested, viz, Louisiana and Texas. The Secretary of Agriculture, however, should have full authority to organize the work for the sole object of securing, as already indicated, the most immediate practical results.

In order to more effectually handle the problems which must necessarily fall to the work of the Division of Entomology, I have already recommended in my estimates that this important branch of the Department be made a bureau. The work that it has done in the past, especially in the field in question, certainly justifies this action; and I most earnestly recommend that this matter be given primary consideration in connection with the entire problem. It is very desirable, furthermore, that the fullest cooperation be effected by the Department with the experiment stations in the respective States, where the more important work will be conducted. This is especially true of Texas, where the Agricultural College is doing everything in its power to aid in the matter, but where it is more or less handicapped by lack of proper facilities and funds.

The fund recommended to be set aside for the purposes mentioned, and used in accordance with the plans outlined, will give the Department such liberty of action as the exigencies of the case demand. An industry which brings to the country an annual income of something over $500,000,000 is threatened, and the time is at hand for energetic action. I again, therefore, most earnestly renew my recommendations for the means and authority to carry out the plans as herein set forth.

Respectfully submitted.

JAMES WILSON,
Secretary.

WASHINGTON, D. C., *November 28, 1903.*

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